NUARY 1957

ry; Zipp
d, London,

al buildings
d., builders,

orth Street
rset Motor
eham.
Kenilworth
, Viewforth,

th Wylam;
ton Street,

on Kitchen
ites; L. J.
ffice fitters,

reet, Stain-
City; T. P.
Bloomsbury

orth, Ltd.,
J. Cearns,
15.
ich Road/
ire Drive,
erk, Green-
o.
ry, Silver-
gar refiners,

Theo. H.
W.1.
Weatherley,

he U.D.C.;
Great North

Tasker &
astle.
– Proposed
k hospital
on Hospital
field Road,
hton, chief

Yorke,
ects, Hyde

more Lane;
Lockhurst

tory and
Cummings,
r, 1.
s (100) at
or.
8); C. M.
rtlepool.
D.C. sur-

nd repairs
for Adams
reet, New-
nd Lamb,
on-Tyne.
ton Castle
ge House,

50); J. L.

es, Bedford
Mauchlen,
12, Saville

ng; British

nd houses
tal Homes,

blocks of
ds Proper-
, W.C 2.

ELECTRICAL REVIEW

JANUARY

UNIVERSITY OF MICHIGAN
Engin
ENGINEERING LIBRARY

WIDE RANGE— WIDE EXPERIENCE

Making motors to suit the drive and the conditions of service is something L.S.E. have been doing rather well for more than seventy years. As a result, quite complex requirements are often satisfied exactly by the right combination of standard L.S.E. motor and L.S.E. control gear, without the need for costly new development.

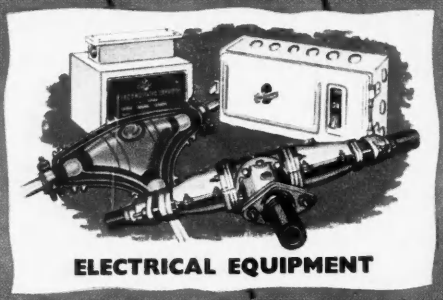
STEEL-FRAME INDUCTION MOTORS
BRITISH STANDARD DIMENSION MOTORS
LAURENCE, SCOTT & ELECTROMOTORS LTD.
"N-S" VARIABLE SPEED A.C. MOTOR
LAURENCE, SCOTT & ELECTROMOTORS LTD.
AUTO-SYNCHRONOUS MOTORS
PROTECTED TYPE INDUSTRIAL A.C. MOTORS
STEEL FRAME DIRECT CURRENT
MILL-TYPE MOTORS
FOR AUXILIARY DRIVES
CONTROL GEAR
STARTING PANELS for N-S
variable speed a.c. motors
THE L.S.E. FLOATING TYPE MOTOR FOR ROLLER-TABLE DRIVES
LAURENCE, SCOTT & ELECTROMOTORS LTD.
"REVCON" CONTROL SYSTEM
CRANES
LAURENCE, SCOTT & ELECTROMOTORS LTD.
THE L.S.E. "TRISLOT" HIGH TORQUE LOW CURRENT SQUIRREL-CAGE MOTOR
LAURENCE, SCOTT & ELECTROMOTORS LTD.

URENCE, SCOTT & ELECTROMOTORS LTD.

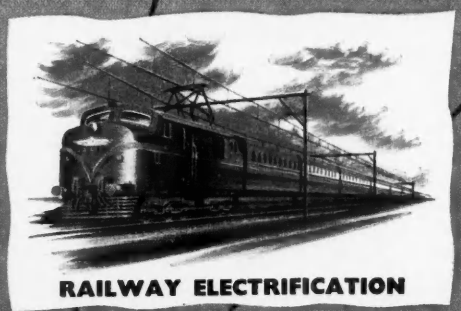
WICH MANCHESTER LONDON AND BRANCHE

OVERHEAD TRANSMISSION LINES

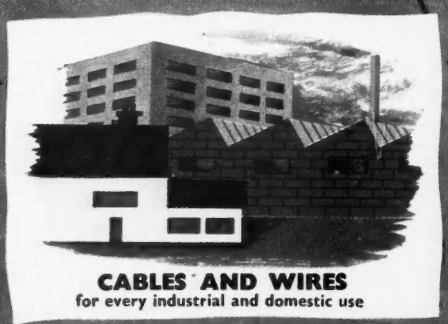
ELECTRIC CABLES
for all working voltages



ELECTRICAL EQUIPMENT



RAILWAY ELECTRIFICATION



CABLES AND WIRES
for every industrial and domestic use

BICC

PRODUCTS AND SERVICES

BRITISH INSULATED CALLENDER'S CABLES LIMITED
21 BLOOMSBURY STREET, LONDON, W.C.1

11 JANUARY
1957

ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E. *General Editor:* J. H. COSENS *Technical Editor:* P. W. TUCKER, M.I.E.E.

In This Issue

The Rate for the Job	47	Attention is drawn to the inadequacy of the salaries paid to the chairmen of Electricity Boards which has a limiting effect upon the remuneration of the senior technical and management staffs
Problems of Arc Control—1	49	Guide to the solution of problems involved in the choice of arc devices for particular purposes
Searching for Undersea Coal	53	An investigation regarding coal reserves embraces a drilling plant in the Firth of Forth. The structure and its equipment are described
Kumasi College of Technology	55	Work is nearing completion on the construction of the first college in West Africa for higher technological education. Particulars are given of the laboratory equipment installed
Electricity Boards	59	The membership of the Central Electricity Authority, the Area Boards and the two Scottish Boards is detailed
Clean Air Act	70	Abstracts of two memoranda circulated by the Ministry of Housing and Local Government for the guidance of local authorities
Electric Heat Treatment Furnaces	71	1,400 deg C still seems to be the limit to the operating temperature of heat treatment elements. Various treatments such as bright hardening or carbonitriding are described
Heat Pump Operation	76	In a paper presented before the I.E.E. Miss M. V. Griffith (E.R.A.) describes the operation and performance of heat pumps and deals specifically with a 10 h.p. unit installed at the E.R.A. Agricultural Establishment at Shinfield
Manufacturing Progress in 1956	77	Among a large volume of orders for heavy electrical plant received from overseas by the English Electric Co., Ltd., last year were two 345 MVA 165 kV generator transformers for the Tennessee Valley Authority. These are claimed to be the largest three-phase units ever to be built

✧ ✧ ✧ ✧

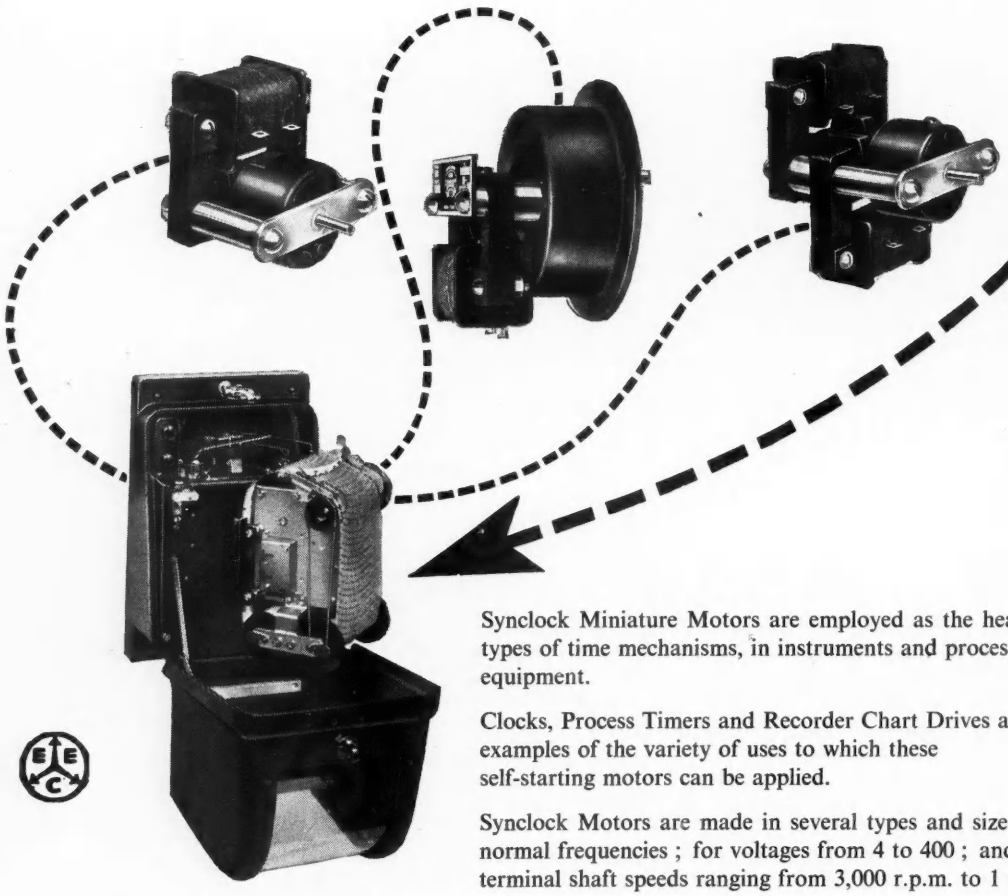
Leaderettes	48	**New L.E.B. Substation**	83
Views on the News	61	**Financial Section**	84
Personal and Social	62	**Next Week's Events**	87
Letters to the Editor	66	**New Patents**	88
Industrial News	67	**Contract Information**	89
New Electrical Equipment	79	*CLASSIFIED ADVERTISEMENTS*	117
Generation and Development	81	*INDEX TO ADVERTISERS*	128

VOLUME 160 NUMBER 2 ✧ *Eighty-Fifth Year of Publication* ✧ FRIDAY PRICE 1s 6d

Editorial, Advertising and Publishing Offices: Dorset House, Stamford Street, London, S.E.1. Telegraphic Address: "Elecrev, Sedist, London." Code: ABC. Telephone No. Waterloo 3333 (60 lines). Registered at the General Post Office as a Newspaper. Entered as Second Class Matter at the New York, U.S.A., Post Office. Annual Subscription: Home and Overseas £4 10s 0d: U.S.A. and Canada $14.00. Cheques and Postal Orders (on Chief Office, London) payable to ELECTRICAL REVIEW PUBLICATIONS LTD. and crossed "Lloyds Bank."

ELECTRIC SYNCLOCK

The power within . . .



Synclock Miniature Motors are employed as the heart of many types of time mechanisms, in instruments and process control equipment.

Clocks, Process Timers and Recorder Chart Drives are three examples of the variety of uses to which these self-starting motors can be applied.

Synclock Motors are made in several types and sizes ; for all normal frequencies ; for voltages from 4 to 400 ; and with terminal shaft speeds ranging from 3,000 r.p.m. to 1 r.p. hour.

For all purposes where the accurate measurement of time is a factor, Synclock Motors are the precise answer.

Catalogue Sheet 600A which describes the range fully will gladly be sent on request.

THE MAJORITY OF SYNCLOCK MOTORS ARE NOW AVAILABLE FOR IMMEDIATE DELIVERY

EVERETT EDGCUMBE

Designers and manufacturers of almost every type of electrical indicating and recording instrument. Specialists in : Speed Recording, Photometry, Process Time Control, Telemetering.

COLINDALE WORKS LONDON N.W.9 TELEPHONE: COLINDALE 6045

DH8

ELECTRICAL REVIEW

11 January 1957 Vol. 160 No. 2 Established 1872

The Rate for the Job

ON page 59 of this issue we give particulars, extracted from the annual report to Parliament by the Financial Secretary to the Treasury, of the membership of the fifteen public Boards which administer electricity supply in Great Britain. In each case the salary paid is shown and a note is made of the expense allowance granted to each Board.

It is a popular trick of the less-scrupulous newspapers to take, say, the salary of the chairman of the Central Electricity Authority (£8,500) and represent it to be a fantastic remuneration. They omit to mention that the holder of this office is responsible for a system with assets valued at nearly £1,400 million and combined revenues of over £380 million a year. They never place the chairman's salary against that of the chairmen of " private " commercial concerns of comparable size (and these are very few) to put the matter in the correct light. The Electricity Boards have assets ranging from about £28 million to nearly £70 million and an annual turnover running from £16½ million to nearly £46 million. It cannot be said that the chairmen and deputy-chairmen are overpaid when their salaries amount to £4,000 and £3,500 respectively. Here we may interpose the question why, with such disparity in size, the salaries should be the same for all areas.

As we state in our summary, there is a footnote in the return which says that one Area Board chairman and two deputy-chairmen " received the higher salaries they were paid as officers of undertakings absorbed by the Act." These were company undertakings of course: engineers employed by local authorities were generally paid inadequate amounts. This is an indication that the proper rates are not being paid for these positions, for the Boards' undertakings are surely more important than the parts of which they were composed.

The subject was discussed at some length in the Herbert Committee's report. First the Committee pointed out that the salaries were fixed in 1947 by the Minister of Fuel and Power and the Treasury on the strange principle that " such salaries should be at some point between those current in the Public Service on the one hand and private business on the other." The Committee found it difficult to understand this philosophy as the electricity supply industry had to compete with private industry for its technical staff, its administrators and its leaders. Accordingly it recommended that the salaries of the chairman and full-time members of the proposed Central Authority should be at least £10,000 and £8,500 respectively; those of the chairman and full-time members of the proposed Generation Board at least £8,500 and £7,000 respectively; while the position of Area Board chairman should command £6,000 for a full-time and £3,000

for a part-time appointment. The remuneration for other part-time appointments to the Central Authority and Boards should be at least £2,500 and £1,000 respectively.

One deleterious result of the low remuneration of the Board chairmen and members is that it imposes limits upon the salaries of senior technical and management staffs. The Herbert Committee pointed out that under the present system the salaries of these staffs "have been compressed between the increased wages and salaries of the lower grades and the fixed remuneration of the Deputy-Chairmen." In its opinion the consequent effect on incentives and differentials was most serious.

The Electricity Bill gives an opportunity for the remedying of these defects. It is to be hoped that the Minister will, in the words of the Herbert Report, "avoid damage to the industry by arbitrary restriction of salaries of top management," bearing in mind that "if these are kept out of scale with outside industry, men who are dissatisfied will leave entirely the industry which in this country is now a public monopoly."

CAROLINE HASLETT

It was a measure of the esteem and affection in which the electrical industry held the late Dame Caroline Haslett that although she had been too ill to appear in public for about three years inquiries were made about her at almost every electrical gathering. Dame Caroline's activities were many and varied, but it was to the electrical industry that she made her greatest contribution and she attained a unique position in the industry. In the sphere of domestic electricity alone she made a profound impression and it is true to say that a great deal of the advance made in the last quarter of a century was due to her work in connection with the Electrical Association for Women which she founded in 1924. Dame Caroline had a practical approach to the matters in which she was interested, derived no doubt from her early experience in the engineering industry, and much of the improvement in the design and construction of electrical appliances can be traced to her influence. The electrical industry was greatly indebted to her and it is to the industry's credit that the debt was so universally acknowledged.

HEATING ELEMENT MATERIALS

We remember many years ago, certainly before the war, commenting on the apparent lack of headway which had been made in the development of electric heating elements, particularly with regard to heat treatment. We showed that the limit of about 1,200 deg C as the operating temperature had remained at that figure for a considerable time, while the limit for non-metallic elements had been about 1,400 deg C. Judging from the article "Electric Heat Treatment Furnaces" by Mr. J. B. Carroll, on page 71 of this i ssue, the present position is much the same because, he says: So far only metallic elements operating up to about 1,100 deg C have been considered. Until recently whenever higher temperatures were required non-metallic elements, e.g., silicone carbide, were used for practical heat treatment. Now, however, a nickel-chromium-aluminium alloy has been developed which is suitable for continuous operation up to about 1,200/1,250 deg C, while Kanthal, a Swedish element material, is alleged to be suitable for use up to 1,350 deg C. It is still, however, more usual to employ silicone carbide elements which are suitable for temperatures up to 1,400 deg C.

We have heard a great deal in recent years about the serious shortage of metallurgists throughout this and other countries, and we are wondering if this slowness of advance is one of the reflections of this serious shortage.

NEW GENERATING PLANT

During 1956 1,937 MW of new generating plant was installed in the generating stations of the Central Electricity Authority and the South of Scotland Electricity Board, which exceeds last year's record total of 1,721 MW by 12½ per cent. Although more generating capacity was installed during the year fewer new power stations have been commissioned. In 1955 seven new major stations were started up whereas last year only four were put into operation and one of these was a small diesel plant. During the year thirty-eight turbo-alternators were commissioned with an aggregate capacity of 1,920 MW and these consisted of one 20 MW, twelve 30 MW, twenty-four 60 MW and one 100 MW sets. It can thus be seen that the larger sizes of generating unit are becoming more commonplace. It is unlikely that in a few years' time sets smaller than about 100 MW will be installed in this country.

HEAT PUMP DEVELOPMENT

High capital cost in relation to load factor appears at present to be the chief deterrent to a wider use of the heat pump. In her I.E.E. paper, reported in this issue, Miss M. V. Griffith referred to its being at an earlier stage of development than any of its competitors and drew the reasonable conclusion that with more experience in operation and wider use efficiency would be increased and first cost lowered. In drawing economic comparisons with other methods of producing warmth, full credit would probably still have to be taken, as in many direct electrical applications, of the cost value of incidental advantages of the system. As the author mentioned, further operational trials to establish the position of the heat pump need to be undertaken, such trials having in view the provision not only of heat but also of information.

WASH BOILERS

The subject of the next of our three-weekly illustrated surveys of domestic electrical appliances will be wash boilers (18th January issue). Particulars will be given, in tabular form, of type, size, tub capacity, loading, method of control, finish, price, etc. On 8th February we shall be dealing with electric irons.

Problems of Arc Control—1

Important Representative Examples

By
H. de B. KNIGHT,
M.Sc., M.I.E.E., F.Inst.P.
(British Thomson-Houston Co., Ltd.)

OF the many problems of arc control, some are still unsolved. There are others whose solutions, though known, have only restricted publication, being classed as manufacturers' "know-how." The designer's problems often involve compromise between conflicting elements. The engineer's problems are the choice of the most suitable device for his particular purpose, and its use to the best advantage, taking full account not only of technical logic but also of price and availability. From all the problems an author can select only representative samples which seem important, or at least interesting.

The arc discharge can be used as a high-speed switch for the regulation of current flow; it is the controlling element in valves such as mercury-arc rectifiers, ignitrons and thyratrons. In the metallic part of the circuit, current conduction is represented by a stream of electrons drifting along the applied electric field, threading their way between the atoms of which the conductors are composed. When they reach the cathode of a discharge gap, electrons take off into space; if a suitable electric field exists between the electrodes, the electrons are accelerated and start the process of collision ionisation of the gas in the gap.

The process is cumulative and proceeds until most of the space (in devices with which we are concerned) is filled with a "plasma" in which gas molecules are interspersed with electrons and positive ions, all moving at high speeds in random directions. The densities of the electrons and of the ions are substantially equal, so that the plasma, as a whole, is electrically neutral; thus it presents little impedance to the drift of the former towards the anode and of the latter towards the cathode.

This drift in the electric field, which constitutes current conduction, consumes very little energy. Conditions are different close to the electrodes, and especially at the cathode, where—in a small space—most of the conduction losses are concentrated. It is an important feature that these losses, represented by the total voltage drop, are lower in the arc than in any other kind of discharge. In standard forms of valve, in which the electrodes are contained in an envelope filled with gas or vapour at a low pressure, the arc voltage drop is generally between 6 and 30 V, though it may be somewhat outside these limits in special cases; it represents the cost, in losses, of using the arc as a switch.

In some devices, such as the thyratron, the cathode is heated to assist electron emission, and a suitable gas or vapour atmosphere is provided after the air has been removed. In others, such as the ignitron, the cathode (a mercury pool) is cold but can supply the necessary vapour for conduction; here the energy for electron emission must be supplied by the discharge itself.

Arc control is of two basic forms—control of direction and control of starting time. The former generally means rectification, with current passing only when one electrode, the anode, is positive with respect to the other, the cathode. (It should be noted here that, except where otherwise stated, all potentials are assumed to be with reference to the cathode.) With a.c. voltage supply this means conduction in alternate half-cycles only. Control is achieved by the establishment of an arc—either by permitting it or by encouraging it—in one direction, and not in the other.

The second basic form of control is to choose the moment at which the arc shall strike; this is generally associated with direction control, so that with an a.c. supply, control of the striking time is exercised in every positive half-cycle of voltage. In "phase control" the arc may strike (either by permission or by encouragement) at any desired point in each half-cycle and current continues to flow each time until the anode voltage falls to zero; this gives smooth regulation of current.

"Permissive" control is exemplified by the hot-cathode thyratron. If the cathode is at a suitable temperature, it is ready to emit electrons, and provided the gas or vapour pressure is adequate, an arc will pass whenever the anode potential is sufficiently positive. The arc is permitted in that direction, except when it is forbidden (or "held off") by potentials applied to the control grid to discourage electron emission until the desired moment for starting. The arc is forbidden at all times in the opposite direction because the anode is relatively cold and there is nothing—ideally—to start electron emission from it when it is at a negative potential.

When once the arc has struck, it cannot be stopped by grid control (except under special and unusual circumstances); its current value and duration are determined almost wholly by the circuit voltage and impedance. The conditions for continuous control are discussed later; they are not at present very practicable but they may have potentialities.

Cold Cathode Arcs

With a cold cathode, such as the mercury pool, neither it nor the anode is initially in an electron-emitting condition; in this case, control is exercised by encouraging emission at the right moment, and at the cathode only. In the ignitron[1] the arc is started by passing a current pulse through a stationary ignitor rod immersed in the mercury; this initiates a cathode spot to which an arc passes if the anode is positive. The arc, initiated at the ignitor, cannot travel far in the course of a half-cycle (of commercial frequency); consequently, the cathode need not be insulated from the envelope.

In the single-anode ignitron there is no ionisation present when the anode is negative; this enables the anode-to-cathode spacing to be reduced, thus keeping the arc voltage drop low, without risk of backfiring. In a typical welder-

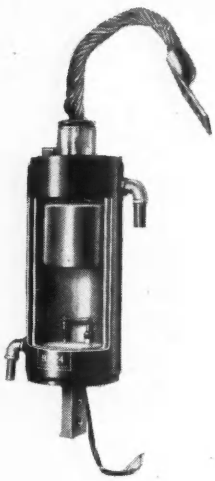


Fig. 1.—Water-cooled steel envelope ignitron, Type BK24, for resistance welding control (cut away to show construction)

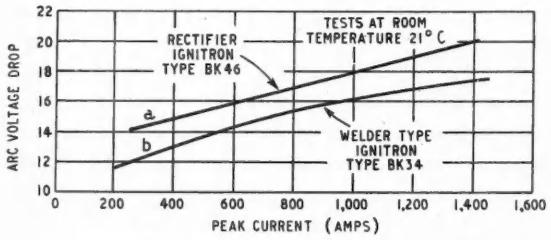


Fig. 2.—Arc-voltage drop against arc current in single-anode ignitrons with 4¾in diameter cathode: (a) shows the rectifier, Type BK46 and (b) the welder control, Type BK34. The higher voltage drop in the rectifier type is due to the presence of de-ionising baffles

control type ignitron, Fig. 1, with a pool cathode 3⅜in in diameter, the voltage drop is about 14 V at 500 A and 28 V at 7,000 A. High peak currents are possible because there are no grids to restrict the arc. Fig. 2 refers to two types of ignitron having cathodes of about 4¾in diameter; the arc drop is slightly increased when baffles are introduced to help de-ionisation.

Valves with cold cathodes may, however, be subject to "permissive" grid control. An example is the grid-controlled "excitron,"[2] a mercury-pool type of valve illustrated in Figs. 3 and 4, in which an arc, kept in continuous operation from an auxiliary anode, provides a "ready-to-emit" cathode, to which an arc can start to the main anode when this is permitted by the grid. It will be seen that some ionisation is present in the valve continuously. Typical values of arc-voltage-drop in an excitron of the type illustrated are shown in Fig. 5, which also illustrates the importance of the mercury vapour pressure, which is a function of the amount and temperature of the cooling air.

A somewhat similar form of control is applied also in special designs of ignitron, such as the pentode type[3] illustrated in Fig. 6, intended for operation at 20 kV, 150 A (mean). Ionisation is not continuous, but is established afresh, by means of the ignitor, and as an arc to an auxiliary anode, just ahead of the time when the main arc is to be allowed. Three grids are seen; the second one is the control grid, shielded by the lower grid from vapour blast from the cathode; the upper grid is to assist high-voltage operation. As might be expected the grids increase the arc voltage drop appreciably.

For descriptions of arc-discharge apparatus as used in present practice in miscellaneous power applications the reader is referred to published papers such as those included in the bibliography.[4, 5, 6]

To leave the cathode, the electrons must acquire energy sufficient to take them past the surface potential barrier, which has the effect of an electrostatic field dragging them back again. The energy required is a characteristic of the surface material; its value is known as the "work function" of the surface. In the hot-cathode thyratron, the electrons receive the necessary energy from outside, supplied by the cathode heating circuit. No such energy source exists for the electrons in a cold cathode; those which succeed in escaping must initiate, not simply an ionisation process, but a self-sustaining regime which feeds back energy to the cathode, sufficient to enable more electrons to break away.

The arc to a mercury-pool cathode is such a regime. The conducting column terminates in a luminous spot, the seat, apparently, of the electron emission. The spot is intensely brilliant and moves rapidly and in a random path over the surface of the cathode (unless "anchored" as described below); its small dimensions indicate a high current density; it is unstable at low currents and extinguishes very rapidly; it causes an appreciable removal of material from the cathode, on which it exerts mechanical pressure, observable by the depression and agitation of the

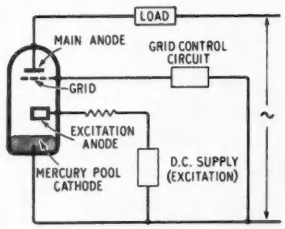


Fig. 3.—Diagrammatic representation of grid-controlled excitron rectifier. This is illustrated as the glass envelope type with the method of initiating the excitation arc not shown

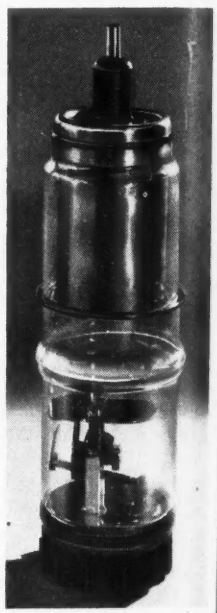


Fig. 4.—Type AR63 h.v. excitron rated at 8,000 V (inverse), 6·25 A (average), or 16,000 V (inverse), 3·75 A (average)

mercury surface; and it may be deflected by a magnetic field, often moving, however, in a direction opposite to that expected from considerations of the left-hand rule.[7] This state of affairs can be supported with a voltage of only about 10 between anode and cathode, less than the ionisation potential of mercury, most of the potential drop occurring within a very minute distance of the cathode surface.

In a study of the emissive spot, almost any experimental observations of its characteristics are of interest and may provide a useful clue as to its mechanism and to the factors governing its behaviour; these are still obscure and are subjects of speculation and research.

The cathode spot, with its rapid and random movements, presents a difficult object for study. Attempts have been made to explore the region by means of probes. Lamar and Compton[8] made measurements within about 0·4 cm of a restricted cathode spot on mercury; they concluded that "the cathode drop is very near to 10 V, from the nearest point at which we can measure," and that beyond this there was a small negative potential gradient. The cathode-fall space could not be measured, but was roughly

estimated to be less than $1{\cdot}76\times10^{-4}$ cm. Probe methods, invaluable in other parts of the discharge, are unreliable here, and only feasible at all when the spot is under restraint.

The intense brilliance of the cathode spot makes visual observation difficult; Haynes[9] recorded an initial intrinsic brightness of the spot on mercury at 10^6 candles/cm^2, which is brighter than the surface of the sun: the light is emitted in a continuous spectrum, offering no precise and detailed spectographic information as to what is going on. In these circumstances much reliance is placed on the camera.

Various methods have been adopted to prevent the random movement of the spot. Among them are the limitation of the available cathode surface,[8,10] spot anchoring,[11,12] and spot movement on a steady circular path in a magnetic field.[13] If the arc is anchored (as described below) its operating characteristics differ from those with the free-moving spot, mainly in the elimination of the vapour blast and the stabilisation of the arc at much lower values of current; sometimes, too, a small change in arc voltage drop is observed. The motion of the cathode spot may also be restricted either by means of an axial magnetic field or by the use of a cathode pool in an annular trough and with a radial magnetic field. In either case the arc voltage drop is generally appreciably higher than with the free spot;[14] for example, in one experiment with a BK.22 ignitron a 5 A arc had a voltage drop of 16 V and this increased to 26 V on the application of an axial magnetic field of about 100 oersteds at the cathode surface.

Thus, while these methods facilitate observation, the conditions differ sensibly from those for the free-moving spot. The mechanisms responsible for electron emission are likely to be much the same whether the spot is free or under constraint, but should not be assumed to be identical.

Cathode Spot Characteristics

The arc is unstable at low current values and is liable to sudden extinction. The lifetime of an unanchored d.c. arc, before it extinguishes, is random; it varies with the pressure (being longer at higher pressures), with the electrode spacing[15] and also with the circuit conditions. In one experimental case the most probable lifetime was about one second at 1 A, one minute at $2\frac{1}{2}$ A and infinite at $3\frac{1}{2}$ A, although a 5 A arc was once observed to extinguish after operating stably for ten minutes. An inductance of 7 mH in series with the arc stabilised it indefinitely at 1·2 A. This may be because the voltage appearing across the inductance on current change encourages the maintenance of emission. This explanation is doubtful, however, because of the rapidity with which the arc-supporting regime collapses when the arc goes out; the arc will not strike again even if the anode-to-cathode voltage is re-applied within 10^{-9} sec.[16]

When the supply is alternating, the arc may go out in each cycle before current zero, possibly inducing voltage surges in inductive elements. The extinction current is generally not more than 1 A, and is smaller the greater the rate of fall of the current, presumably because of the persistence of ionisation.

When the cathode spot is anchored it is stable at much lower currents; Tonks[12] noted stability under these conditions down to 0·5 A, and von Bertele[17] claims that currents of about 0·1 A can be maintained with low-heat-resistance anchors. Von Engel and Steenbeck[18] record arc stability at 0·05 A with an amalgamated porous-tungsten anchor. They also state that a minimum arc current of about 0·1 A is stable without anchoring in an argon-filled rectifier with a cathode of potassium/sodium amalgam, although Hellmuth[19] gives the minimum as 0·25 A.

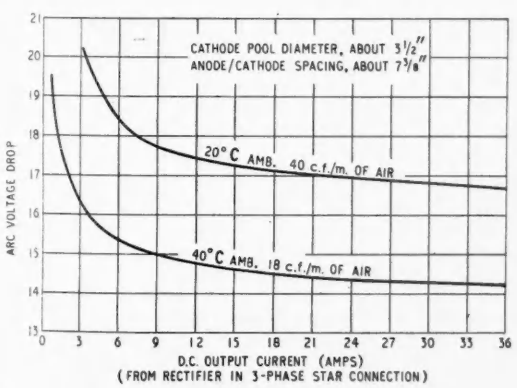
The uncertainty as to the theory of cathode spot emission leaves in doubt the reason for instability at low currents; presumably the density of particles, charged and uncharged, in the emitting area is insufficient to ensure adequate emission of electrons or build-up of ionisation in the space available.

The arc exerts a pressure, depressing the mercury level (when the spot is free) and causing considerable agitation. Kobel[10] estimated a pressure of nearly 100,000 dynes/cm^2 at a spot on a restricted area. Tonks[11] found that the force per unit current at an anchored spot varied with the current; it was 66 dynes per ampere for a current of 10 A.

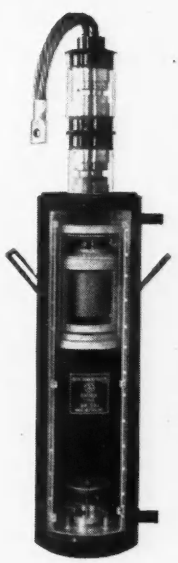
Mercury is removed from the cathode by two processes; one is evaporation and the other a vapour blast with a velocity of over 10^6 cm/sec[10] and including visible droplets; the blast is believed to be absent when the spot is anchored. An early estimate[20] of 22×10^{-4} g/coulomb included the total from both causes. Tonks[12] made measurements with an anchored spot, and thus estimated the evaporation alone. His readings showed that the rate of evaporation increased with either arc current or cathode temperature; extrapolation to zero current and low temperatures gave a figure of $2{\cdot}5\times10^{-4}$ g/coulomb.

The vapour blast associated with non-anchored cathodes has its advantages. In the mercury ignitron a very high rate of current rise can be realised, much higher, for example, than with a mercury-vapour thyratron operating at the same general level of vapour pressure; this is believed to be due to the very localised high pressure near the cathode spot, which is also considered[21] to be responsible for the high fault-current capacity of the ignitron.

An arc cathode spot will become "anchored" to a body of suitable material projecting above the level of the liquid,[11,12,17] provided it is wetted by the mercury. Suitable materials are molybdenum and tungsten; they have a high melting point and are not liable to be excessively eroded by the arc, nor to react chemically with the mercury or go into solution. Also they are wetted by mercury if their


CATHODE POOL DIAMETER, ABOUT 3½"
ANODE/CATHODE SPACING, ABOUT 7⅜"
20° C AMB. 40 c.f./m. OF AIR
40°C AMB. 18 c.f./m. OF AIR
ARC VOLTAGE DROP
D.C. OUTPUT CURRENT (AMPS)
(FROM RECTIFIER IN 3-PHASE STAR CONNECTION)

Above: Fig. 5.—Arc voltage drop in an AR63 excitron as a function of arc current and of temperature. The current shown is the d.c. output current from three rectifiers in three-phase star connection: the peak current in each rectifier is about 20 per cent higher. Right: Fig. 6.—Pentode type ignitron Type BK56, cut away to show the construction. The rating is 20 kV, 150 A (mean) continuous



surface has been carefully cleaned, for example, by firing in hydrogen or by ion bombardment. A film of mercury condenses on the anchor and the surface of the pool meets it with a concave meniscus, which is associated with wetting.

The arc spot first becomes fixed at a point on the line of immersion of the anchor; as the current is increased the "spot" becomes drawn out into a line of increasing length. Above a limiting value of current the arc spot breaks free and wetting of the anchor may disappear. Smith[22] observed, in tests with an applied magnetic field, that in some circumstances the spot may migrate to parts of the anchor above and remote from the immersion line.

It is a matter of observation that, as compared with the free moving spot, the anchored spot gives a reduction in the quantity of material removed from the cathode, and a greater stability at low currents. But why does the spot become anchored? And why is the vapour blast suppressed? The spot remains fixed to the anchor because the voltage drop is generally a volt or two lower than when it is unanchored;[17] but that only restates the question in another form. Why is the voltage drop lower? (It is worth noting that anchoring may take place at low currents in spite of a slightly increased voltage drop.)

Von Bertele[17] suggests that the molecular interaction occurring when mercury wets the anchor material produces a structure with a work function lower than that of pure mercury. Certainly anchoring does not occur except at such a composite, mercury-wet surface. The suppression of the mercury-vapour blast may be because the mechanical pressure of the arc falls on an unyielding surface, on which there is only a thin layer of mercury.

As already explained, the single-anode ignitron has a low arc-voltage drop because of the small anode-to-cathode spacing, made possible by the absence of ionisation during the negative half-cycle of anode voltage. The spacing can be still further reduced when the cathode spot is anchored, owing to the absence of vapour blast.

In an early design of ignitron,[23] the anchor was in the form of a molybdenum-covered steel pipe which could be water-cooled to reduce mercury evaporation. In another type of valve[17] the mercury cathode is contained in a molybdenum cup, which is also part of the envelope and can be well cooled. Fig. 7 shows features of this design.

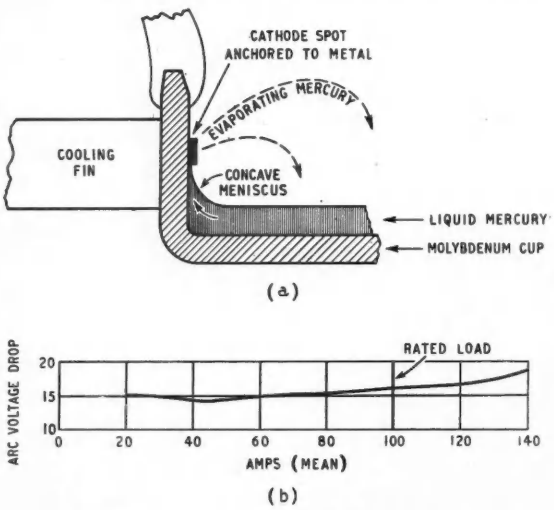


Fig. 7.—Shown at (a) is a diagrammatic representation of the cathode of a "Nevitron" type of excitron, showing the closed loop of mercury flow. At (b) is plotted the arc voltage drop in a grid controlled "Nevitron" rectifier Type R101G. The envelope diameter of this is about 3½in and the tests were made at room temperature. The currents shown are mean currents in a half wave rectification circuit: the peak currents are π times the values shown

As is well known, there are limitations to cooling and dangers are involved in over-cooling; if the vapour pressure is too low there is a possibility of high-voltage surges due to arc quenching,[24] and the rate of rise of current, on initial ionisation, may be seriously limited.[15] Fig. 8 illustrates the latter effect in an ignitron in a pulsing circuit.

As already described, the arc can be deflected by a magnetic field; but while the arc column obeys the left-hand rule, the spot on the cathode may move in the opposite direction. The phenomenon has been observed with a large number of different cathode materials and gas fillings.[14] If the arc is supplied from a d.c. source, the spot moves in a circular path on the cathode surface: its velocity of rotation increases with the arc current and with the magnetic field, but decreases with increasing gas or vapour pressure. As the pressure is increased, the spot slows down, then reverses and goes in the "right" direction; a similar effect is observed as the field is reduced. Smith[25] recorded a velocity six times as high as the speed of sound in the mercury vapour for a spot moving in a high magnetic field along an anchoring surface.

Robson and von Engel[26] were the first to propose a theory of the phenomenon, which they think is occasioned by the self-magnetic field due to the curvature of the arc itself. The constricted part of the positive column immediately above the cathode-fall region is deflected by

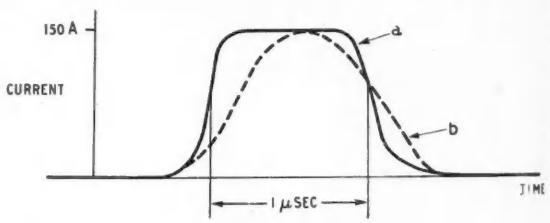


Fig. 8.—The current through an ignitron in a pulsing circuit. (a) is for a valve temperature at the coldest spot of 20 deg C, and (b) for a similar temperature of 0 deg C

the field according to the standard rule; this causes a sharp bend in the conductor constituted by the arc column and the cathode, and the magnetic field due to the arc current in this bend produces a force driving the junction in the "retrograde" direction. The force is increased when either the arc current or the magnetic field is increased, or the vapour pressure decreased.

St. John and Winans[27] question this theory as it does not account for the sudden increase in spot velocity which takes place at a certain field strength as the field is increased.[25] According to their own theory the voltage fall across the cathode dark space is 20 to 30 V (confirmed by spectral evidence); beyond this is an electron cloud, giving a voltage gradient in the opposite direction; this results in the observed overall anode-to-cathode voltage of only 12 to 15 V. The positive ions produced by electron collisions beyond the dark space return to the cathode, but are subject to the attraction not only of the cathode but also of the electron cloud outside it. They overshoot the spot from which the original electrons emerged, meeting the cathode (and there liberating more electrons) at a point in a retrograde direction.

Estimates of the current density of the cathode emitting-spot range from 4,000 A/cm² (Güntherschulze, 1922[20]) to 10^7 A/cm² (Froome, 1953[28,29]); with an observation of 10 A/cm² (Smith, 1953[30]) from cathode "patches," in

which, it has been suggested, a different emission mechanism may be involved. Froome observed that the familiar bright spot is a relatively slow-moving envelope inside which are several fast-moving, minute spots, each carrying a current of about 1 A; it is to these tiny areas, which are considered to be the seat of the emission, that his current density measurements apply. Measurements on the whole envelope (commonly called the cathode spot), might give Güntherschulze's figure.

The cathode spot is thus a group of primary emissive spots, and as the current increases, two or more such groups are formed. Measurements made on what Froome calls the envelope, may be variable, because, according to both Haynes[9] and von Bertele[31] its area increases with time; this does not apply to the measurements on the primary emissive spots whose size is said not to vary with time.

Smith[30] records observations of an arc spot spreading uniformly as a patch over the surface of a spot-anchoring device in a magnetic field, and giving a current density as low as 10 A/cm^2; at high magnetic field densities the patch was seen to contain a multitude of small bright spots. This might suggest that besides the high-density emission studied by Froome there may also be low-density emission from larger areas, perhaps with a different emission mechanism.

The apparent possibility of emission at low current density has given rise to suggestions[32] for a novel type of rectifier, with a cathode in the form of an extended and well-cooled anchoring surface, wetted by a film of mercury, and with close anode-to-cathode spacing.

The existence of two different arc-spot mechanisms has yet to be confirmed; neither is easy to explain, especially in view of the low arc-voltage drop, in which none of the charged particles is accelerated to very high energy. Various theories have been advanced to account for the electron emission and different methods have been proposed for controlling it. These will be studied in the next section.

[Note.—A bibliography common to the three parts of this article will be attached to the last one.—Editors, *Electrical Review*.]

Searching for Undersea Coal

In a lecture to the Association of Supervising Electrical Engineers in London recently Mr. W. H. Brooks compared the probable demand for coal for various purposes with the estimated output and argued that no improvement could be expected unless the deficiency in manpower was corrected, despite the greater mechanisation that had been introduced in some of the pits. A greater utilisation of the right coals in the right places was therefore of vital importance and a transfer from one kind of energy to another should be made by certain types of consumer so that the best use could be made of coal of whatever quality.

The employment of nuclear energy would relieve the mining industry of some of its burdens and would enable coal to be directed to those industries which had no alternative choice of fuels or which could profitably extract a greater value from its by-products. Economies could also be effected by gradually directing domestic demands to the use of electricity or gas for space heating. Against this must be set the possibility of a serious curtailment in our oil supplies, due to recent events in the Middle East. In 1965 our inland fuel requirements might exceed 300 million tons of coal equivalent a year of which half might be needed by industry and a quarter by households. About 75 per cent of these requirements would come from home-produced coal and 3 per cent from nuclear power and hydro electricity, so that we might have to look to oil for 22 per cent of our needs.

Accurate Knowledge of Resources

This increased demand for coal, continued the lecturer, emphasised the need for accurate knowledge of our resources in order that development could be economically planned. The National Coal Board was therefore extending its search not only into known regions of reserves, but to hitherto "uncharted" areas, including those beneath the sea bed round our shores. Included in this investigation was an operation undertaken to obtain information regarding the coal reserves beneath the sea bed in the Firth of Forth. Hitherto such exploration had been restricted to drivage into a known seam and then boring up and down the measures. This was a slow and costly process and the alternative of using portable equipment to drill through the sea bed to ascertain the strata data not only below the sea in the Firth of Forth, but in other areas, was considered. As a result, Messrs. Posford, Pavry & Partners designed a drilling platform the working possibilities of which were demonstrated on a model, while the National Coal Board carried out seismic investigations on the site. To confirm the strata construction obtained from this survey it was decided to attempt the drilling of the sea bed.

Undersea Drilling Equipment

Mr. Brooks devoted the remainder of his lecture to a detailed description of the structure and its equipment, which had been designed for the purpose. Briefly, it consisted of a four-sided tower 130ft high, the legs of which were set up on a fabricated box-girder base of cruciform design. Each of the two sections of this base was 165ft long, 7ft high and 3ft wide, while the total weight was about 80 tons. Each section was divided into four compartments, which could be filled with compressed air to assist in floating the tower or with sea water to provide stability during operations. The tower was designed for use in the seaway at depths of 120ft. It would stand firm in an 80 m.p.h. gale and be unaffected by 30ft waves. Its total weight was 580 tons. The conventional drilling rig stood 54ft above the deck and a 24in guide tube was used to facilitate housing.

All the services on the tower, with the exception of the drill, were electrically operated and in considering the accommodation for the necessary generators the weight distribution over the structural members, the limited space available and the need for quiet running had to be considered. The final choice was for three-cylinder oil engines running at 500 r.p.m. each with a rated output of 100 h.p. and of the two-cycle type with post-controlled loop scavenge and exhaust pulse pressure charging. These engines were installed between the plate girders of the accommodation deck on which timber pads were mounted. Special anti-vibration units were fitted between the pads and the headplates, thus isolating the engines from the main floor.

Each engine was coupled to a d.c. compound wound generator with an output of 50 kW at 440/220 V on the

three-wire system. The three generators were connected in parallel. D.c. was used as four sets of winders were required to raise the 580 ton tower and simple control was desirable.

Two pontoons were used for transporting the tower from one site to another and each was equipped with two 45 h.p. electrically driven winders with a capacity of 30 tons. These winders operated steel wire ropes, which were attached to four points on the base of the tower. Each motor was controlled by a contactor type circuit-breaker, which was provided with stalling protection in addition to overload and under-voltage releases. Push-button control was interlocked with the main isolating switch and the speed was controlled by a reversing drum type controller. This gave the normal hoist characteristics, dynamic braking for lowering and facilities for light hook lowering.

Power from the generators was supplied to the pontoons through flexible cables which were run over drums and to the end of which couplers were fitted. A pillar on each pontoon carried a 300 A switch socket into which the small coupler was fitted and interlocked.

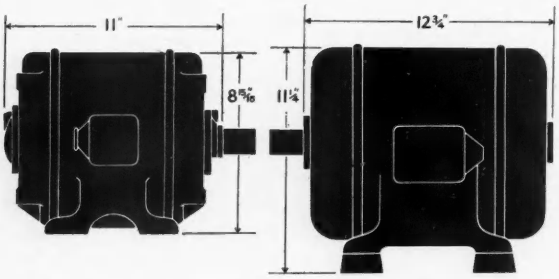
The tower was first launched in the spring of 1955 and the subsequent drilling operations, which were carried out until the middle of November of that year, disclosed the existence of five workable seams with a thickness of 16ft or more and estimated as equivalent to about 40 million tons. In April, 1956, the boring unit was moved to a second site three miles from the shore at which operations not only confirmed the existence of productive coal resources, but enabled the building of the New Seafield Colliery to be planned most economically. It was intended to use this method of obtaining the geophysical information regarding undersea formations in other parts of the coastal areas and then to provide data which could be used for extending shore-based colliery working and for designing the new conceptions of mining which might be required for twenty, thirty or forty years hence.

Class E Insulated Motors

IN line with the draft B.S. CW(ELE)6246, and in anticipation of an amendment to B.S. 2613 which is shortly to be published, Crompton Parkinson, Ltd., have developed and commenced production of a new range of standard, ventilated type a.c. squirrel-cage, three-phase motors. These "Series 5" machines range from 1 h.p., four-pole up to 50 h.p., two-pole.

The use of Class E insulation allows the motors to operate at continuous maximum ratings with a temperature rise of 65 deg C. Furthermore, an improved cooling system has enabled the size and weight to be considerably reduced and the protective enclosure to be improved. Compared with the machines they supersede "Series 5" motors may be as much as 40 per cent lighter and take up only 60 per cent of the space. Consequently, purchasers can expect a reduction in prices.

The machines are of a radially ventilated design whereby cooling air is drawn in through the lower portions of both endshields, directed by means of baffles over the bearings and towards the centre of the machine, being passed radially outwards over the end-turns, round between the core and the shell, and then released from the motor through openings in the sides and base of the machine. This arrangement enables motors to operate at temperatures up to 65 deg C above ambient, and the bearings will become no hotter than those in earlier motors designed for temperature rises not exceeding 55 deg C. An important point where motors have to be installed near to machine operators is the low velocity and diffusion of the air on being discharged from the motors, so avoiding personal discomfort. The fans,



Comparison between new and old type 3 h.p. four-pole motors

Selection of Crompton Parkinson "Series 5" motors with Class E insulation

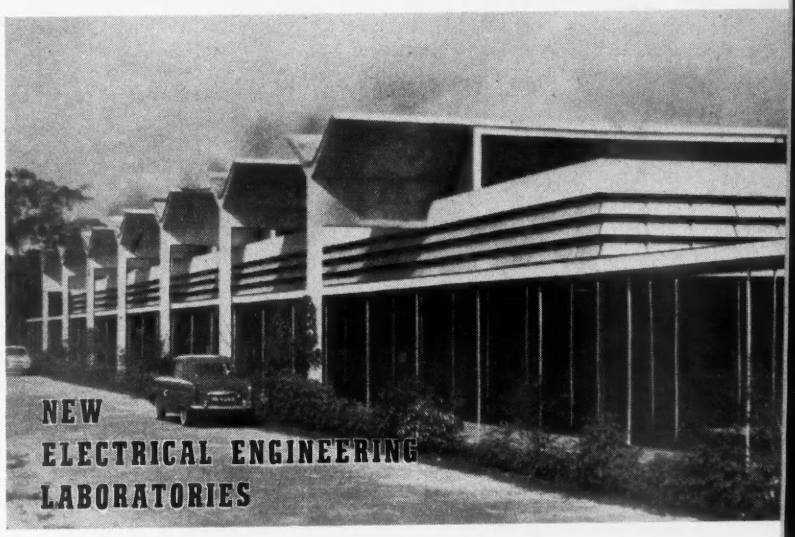
one at each end, are integral parts of the rotor, and the baffles which direct the cooling air also serve as protective shrouds over the end-turns to make it impossible to touch the windings from the outside of the motor.

Apart from the reduced dimensions, one of the more obvious improvements is in the design of the endshields, which are now identical for each end of a machine. They are of solid construction and provide more protection than do the standard screen type which they supersede. The stators have the same robust cast-iron construction of the earlier machines, but the windings are constructed of synthetic-enamel covered wire in slots lined with polyester film on leatheroid.

The rotors are die-cast in the smaller machines and this feature is being progressively extended to cover the larger sizes. The bearings are either ball or roller, or a combination of both, depending on the duty of the machine. Another useful innovation is the adoption of unified threads for all screws employed. The motors have the same main dimensions as those laid down for equivalent N.E.M.A. frames, except that the new British machines have shafts of slightly larger diameter to cater for the larger outputs developed in the same frame sizes.

KUMASI COLLEGE OF TECHNOLOGY

By H. WARDLE, B.Sc.



As a result of recommendations made by an advisory committee to the Secretary of State for the Colonies, it was decided to establish a college for higher technological education in the Gold Coast. Here, in a rapidly developing country on the threshold of complete self-government, there is an urgent need for qualified engineers.

In 1950 a site was chosen near Kumasi, the chief town of Ashanti. Temporary teaching and residential buildings were erected in 1951 and in March, 1952, the forest was cut down, an area cleared and work on the engineering laboratory, drawing office and lecture room blocks commenced. This work is now nearing completion and most of the necessary equipment has been installed. The facilities available for the training of engineers have been inspected by a delegation from London University and approval has been granted to the college to prepare students for external degrees in engineering. At present this is the only college in West Africa to offer engineering courses to this level.

Students enter the college with the General Certificate of Education and pursue a course of study over a period of two years in the basic scientific subjects of mathematics, physics and chemistry. They then enter on the degree course which extends over a further three years. Provision is made for post-graduate research work and a number of staff are already engaged on research projects.

Laboratory Buildings and Supplies

When completed the electrical engineering department will include laboratories, some of which will be air-conditioned, suitable for experimental work on electrical machines, high voltage testing, radio and telecommunications, and electrical measurements. The total floor area including a workshop and switchroom will be approximately 8,000 sq ft. The internal height of the laboratory block is 16ft and partitioning walls 10ft high divide it into the various laboratories. Some of the dividing walls are of a honeycomb structure to assist ventilation. They are built of concrete blocks and thus enable any future modifications which may be required to the internal layout of the buildings to be made with comparative ease.

The main considerations which influenced the layout of apparatus in the laboratories themselves were that adequate space must be available between and around machines and

The title picture shows one of the laboratory and workshop buildings and shown below is part of the general machines laboratory

experimental units, and that the equipment should be installed in such a manner that if rearrangement should become necessary then this could be carried out with the minimum of disturbance. A "flexible" distribution system has been employed including the use of cable trunking along the walls and benches. There are three floor ducts running the length of the general machines laboratory. Tubes of 2½in diameter are laid under the surface of the floor connecting the centre and side ducts.

Small machine sets are mounted on heavy mahogany benches and most of these are placed at an angle of 45 deg to the axes of the laboratory. The control gear and terminal panels are mounted on frames above the benches and larger machine sets have been mounted directly on the floor behind. The backs of the benches form suitable frames to take the heavier machine set control gear and terminal panels.

The main alternating current supply in the electrical laboratories is a 200 V three-phase four-wire system. It is obtained from the general college supply through a 400/200 V transformer which also serves as a demonstration unit. The transformer is fitted with off-load tap changing and is enclosed in an 11 kV tank complete with bushings, oil conservator and dehydrating breather. Metering of the a.c. supply is carried out on an instrument panel. Links shielded by a removable cover are provided on the panel in all metering circuits. Utilising the terminals on this panel the connection of external indicating, recording and integrating instruments may be easily demonstrated.

A d.c. laboratory supply is obtained from a 15 kW generator driven by a three-phase induction motor. The d.c. metering panel has links for external meter connections. A 10 kW mercury-arc rectifier may be used as an alternative d.c. source of supply. A battery board is being installed to supply a number of bench points. The battery will consist of 55 cells with a 100 Ah rating. By means of paralleling links it will be possible to obtain currents of up to 240 A at 10 V.

Benches in the laboratories are provided with 5 A and 15 A supplies of 115 V single-phase, 200 V three-phase and 200 V d.c. Single-phase 240 V points are being installed close to all machines to facilitate the connection of mains apparatus. As wide a range of different types of cable as possible has been used in the installations, largely with a view to seeing how different insulating materials react to the tropical conditions in a country where at present most wiring is tough-rubber-sheathed or mineral-insulated-copper-covered. In addition to the electrical supplies water supplies are also available in the machines laboratories for such purposes as the cooling of friction brakes.

Laboratory Equipment

In equipping these laboratories a wide range of modern apparatus has been included. To facilitate the connecting of machines and control gear, connections have been brought out to terminals on engraved panels. In order that students may be able to see clearly such items as brush-gear, commutators and slip-rings, use has been made of "Perspex" covers. All machine sets are provided with easily detachable couplings protected by guards. Bed-plates for sets in the advanced machines laboratory are being prefabricated in the workshop and each bed-plate will be of sufficient length to accommodate three machines of average laboratory size. Machines have double-shaft extensions and various types of electrical and mechanical brakes are being used.

Much time is often wasted by students in electrical laboratories preparing connecting leads. To avoid this ready-made p.v.c. insulated and sheathed flexible leads in a range of assorted sizes have been provided. Tool boards accommodating pliers, screwdrivers, adjustable spanner and knife are mounted in accessible positions.

Direct current machines include series, shunt and compound wound types. Two of the compound wound machines are designed for investigating the effects of interpoles. One of these has slip-rings connected to adjacent commutator bars and the field form of the machine may be depicted on an oscilloscope. The other machine is fitted with pilot exploring brushes and the voltage distribution round the commutator may be ascertained. Other compound wound sets are suitable for regenerative testing and running as rotary balancers in a three-wire demonstration distribution system.

A six-anode grid controlled mercury-arc rectifier is designed as an experimental unit. It has a capacity of 10 kW, is fan cooled and suitable for direct or inverted operation. Links are provided in all circuits for metering purposes. An amplidyne set with four primary control fields is being included in the advanced machines laboratory. It may be used as an individual cross-field machine or as one component of a complete control system.

Alternating current equipment includes a comprehensive selection of rotating machines and transformers. A 4 kVA salient-pole rotating field machine is suitable for connection as a synchronous motor or generator. Load tests may be carried out and the machine connected in parallel with the laboratory supply. A synchronising panel, incorporating a voltmeter, synchroscope, synchronising plugs and lamps is mounted as a portable unit.

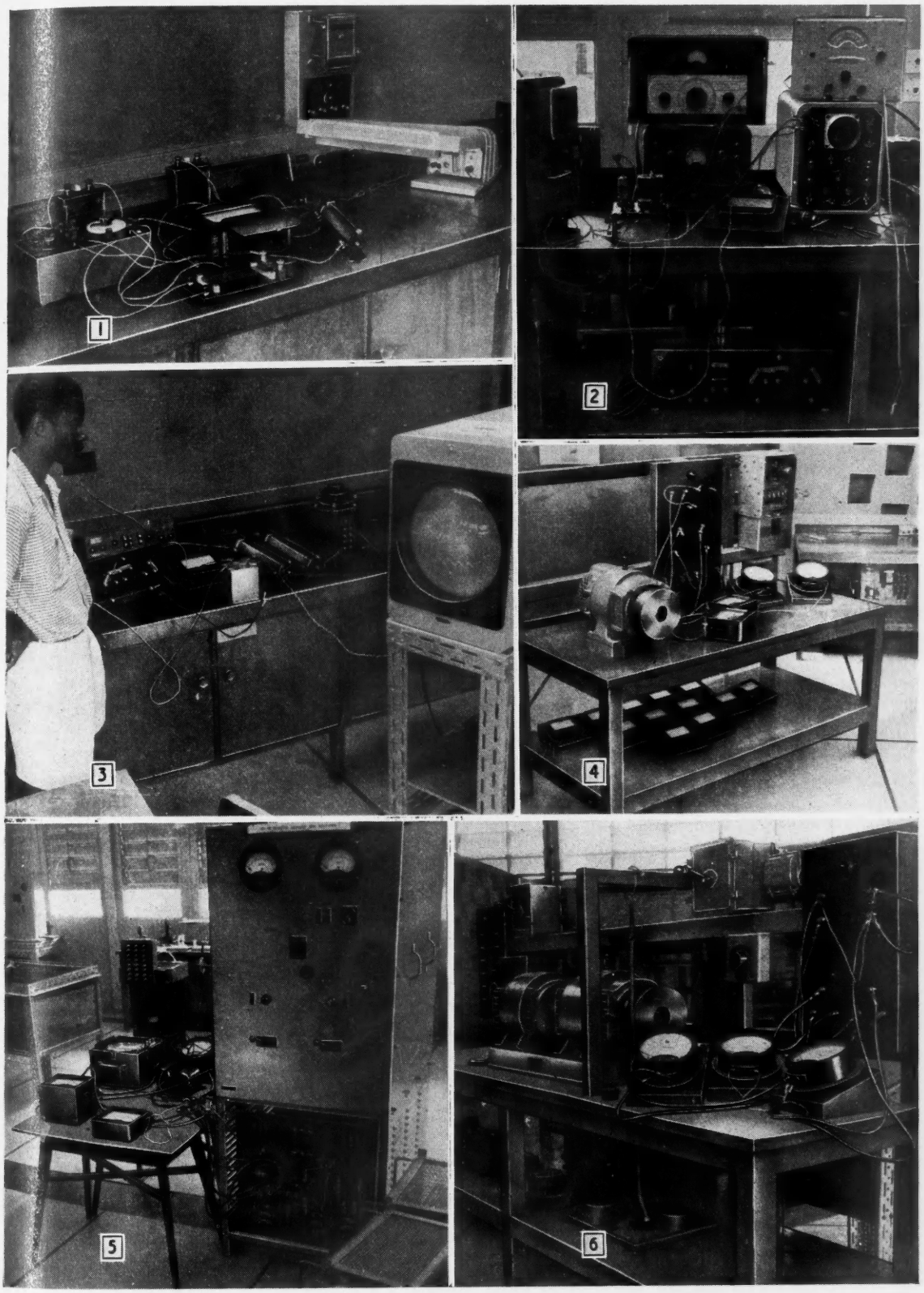
A 3 h.p. slip-ring motor is loaded to a mechanical brake and a four-speed squirrel cage machine is coupled to an eddy current brake mounted on trunnion bearings. In the advanced machines laboratory an experimental polyphase a.c. commutator motor is coupled to a rotary convertor. A servo-mechanism control system is being developed for this set. The a.c. machine may also be used to demonstrate the principles of a compensated induction motor and a self-driven frequency changer. The rotary convertor is an educational unit carrying six slip-rings and is suitable for direct or inverted operation.

A three-machine set is expected to arrive shortly. This set consists of two a.c. machines with a d.c. swinging field dynamometer between them. One of the a.c. machines is a 5 h.p. auto-synchronous induction motor while the other is of the squirrel cage type provided with interchangeable normal and high torque rotors. The two a.c. machines may be operated in cascade. The dynamometer is shunt wound and may be used in loading or driving the a.c. machines. Fractional horsepower split-phase, capacitor and repulsion start induction motors are also being installed on a test bench.

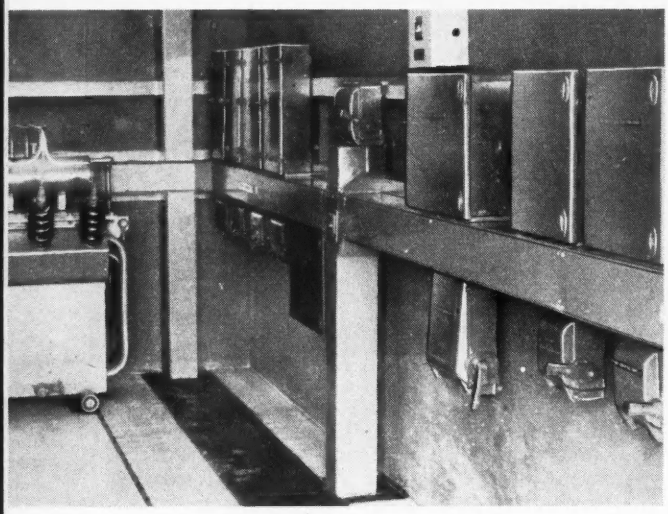
Three-phase and single-phase transformers suitable for normal or Scott connection are mounted as portable units on rubber tread swivel rollers. Thermo-couples are embedded in the windings. A three-phase moving coil voltage regulator is suitable for use as a control unit, a transformer with high or low reactance, an auto-transformer or variable choke. An induction regulator with built-in fan ventilation and sectionalised windings is also portably mounted. Single and duplex variable output auto-transformers are also provided.

Subjects in which the radio and telecommunications equipment is required occur in the later years of the courses. At present, however, the equipment available includes multi-range universal test instruments, valve voltmeters, capacity and resistance analysers, power output meters, stabilised power supplies, signal generators and oscilloscopes. One of the latter has a 15in diameter screen and is suitable for lecture room use.

Demonstration and experimental apparatus now being



1. *Students' apparatus for ammeter calibration.* 2. *Light current laboratory apparatus in the course of construction and testing.* 3. *Investigating valve rectification.* 4. *A slip-ring induction motor.* 5. *Mercury-arc rectifier arranged for experimental use.* 6. *D.c. machines arranged for testing*



Corner of the electrical switchroom

constructed includes voltage stabilised power supplies, power packs and a cathode ray oscilloscope with the various stages arranged as individual units. Boards with components mounted enable valve characteristics to be obtained, various oscillator circuits to be constructed and the characteristics of different types of amplifier coupling to be investigated.

An educational automatic telephone exchange unit is included to demonstrate the operation of such equipment.

The electrical instruments include a wide range of indicating voltmeters and ammeters together with recording instruments. Wattmeters, single- and poly-phase power factor meters, current transformers and frequency meters are also included. Most of the indicating instruments have knife-edge pointers and the movements are clearly visible through glass covers. Sub-standard instruments are used for checking instrument calibrations and later it is hoped to include a standard d.c. potentiometer.

Integrating instruments include d.c. and a.c. watt-hour meters, single- and poly-phase maximum demand indicators and prepayment meters. A gift of protective system relays enables simple methods of protection to be demonstrated. Slide wire bridges, simple potentiometers, and students' type d.c. and a.c. potentiometers, together with fluxmeters and ballistic galvanometers are also provided. An electrolytic tank for the study of electrical fields is being built. Tachometers, phase sequence indicators, and resistance measuring instruments are included in the machines laboratories and workshop. Bench and integrating cube photometers are provided for photometric measurements.

The electrical workshop is in the charge of a European technician and in addition to the installing of electrical equipment experimental apparatus is constructed by the workshop staff. The usual bench tools, along with small power operated tools, an instrument maker's lathe, and a travelling crane are available. Details of instrument repairs and technical data referring to the machines and any modifications made are carefully recorded. Students in the early years of their courses spend half a day each week in the workshops and gain experience in the use of tools and electrical installation work. Consumable materials are often difficult to obtain locally. To overcome this stores have been provided and adequate minimum stocks of these materials are maintained.

Mexican Electrical Market

Opportunities for British Manufacturers

DESPITE the strategic position of the United States as Mexico's main supplier, European countries ought to fulfil a far greater proportion of Mexican import requirements than at present, and United Kingdom manufacturers ought to be in the vanguard of those European countries seeking the additional orders which can feasibly be secured. This is the view of Mr. R. G. Stone, Counsellor (Commercial) to H.M. Embassy, Mexico City, in his report on the economic and commercial conditions in Mexico, published by H.M. Stationery Office, price 5s 6d net.

Mr. Stone points out that present and future opportunities for British manufacturers lie in the capital goods field, and that their great problem is how to give a service similar to that provided by manufacturers in the United States, who, because of the proximity of the two countries, look upon the Mexican market as an extension of their home market. This problem is one which must be solved by British manufacturers if they are to make headway in the market for capital goods.

Dealing with the imports into Mexico of the various classes of electrical goods, Mr. Stone says that machinery, apparatus and equipment is the most important group, the value of which in 1954 was 1,333·9 million pesos; it consists of machinery of all kinds. Some of these goods are now being manufactured locally and such items as pumps, transformers, generators and motors are on the list of goods requiring an import permit.

Imports of electrical installation materials amounted to 88·4 million pesos in 1954; many of the items are manufactured in Mexico and some are on the import licensing list. The value of imports of conductor wire and cables was 14 million pesos in 1954, and these too are on the import licensing list. Electrical accessories were valued at approximately 20 million pesos in 1954. Many of these goods came from the United States, but the United Kingdom has been able to make sales. In the telephone and telegraphic equipment group there is little fluctuation year by year in Mexican purchases, Sweden being the main supplier of telephone equipment and the United States the communication equipment in 1954. Imports in that year were valued at 29·5 million pesos.

Dealing specifically with United Kingdom opportunities in Mexico, Mr. Stone says that the United Kingdom has been so occupied in other markets that there is little of British capital goods to be seen in Mexico as examples of what Britain produces to-day, and often the excuse for not buying British goods is that they are not known in Mexico. Whereas fifty years ago Mexicans went to school in England, to-day they go to the United States. Everything, therefore, should be done to attract Mexican technicians to the United Kingdom where they can look at and examine British products. Large electrical equipment has not been bought in the United Kingdom because our deliveries, and usually our prices, have been out of line.

In a chapter dealing with the Mexican electricity supply industry the report states that the installed capacity in Mexican power stations at the end of 1955 was 1·9 million kW, of which 47·8 per cent was hydro-electric, 40·8 per cent steam, 10 per cent diesel, and 1·4 per cent other internal combustion. The plan is to reach an installed capacity of over 3 million kW by 1963. About half of the new plant will be thermo-electric and half hydro-electric.

ELECTRICITY BOARDS

Members and Terms of Appointment

THE annual return of members of public boards of a commercial character has been presented to Parliament by the Financial Secretary to the Treasury (Cmd. 43, H.M. Stationery Office, 1s). It shows the position as at 1st November, 1956, and because of the changes proposed in the Electricity Bill now before Parliament we think it will interest our readers to be given details of the membership of the Central Electricity Authority and Area Boards. To complete the picture we also deal with the two Scottish Boards.

Particulars of the C.E.A. appear in the following table:—

Designation	Name	Salary	Date of expiry of appointment
Chairman	Lord Citrine	£8,500	14th August, 1957
Deputy-Chairman	Sir Henry Self	£5,000	14th August, 1957
,, ,,	Mr. J. Eccles	,,	31st December, 1958
Member (part-time)	Lt.-Col. E. H. E. Woodward	£1,000*	14th August, 1957
,, ,, ,,	Sir Leslie Nicholls	£500	31st May, 1958
,, ,, ,,	Mr. G. A. S. Nairn	£750	4th June, 1958

* Members appointed to the C.E.A. before 31st December, 1950, receive £1,000.

In addition to these, four Area Board chairmen—Messrs. N. Elliott (*South Eastern*), C. R. King (*East Midlands*), L. Howles (*South Wales*) and D. H. Kendon (*Merseyside and North Wales*)—are part-time members of the Central Authority until 31st December, 1957.

The Central Authority as a whole receives an allowance of £2,250 per annum but it is noted that this and similar allowances do not provide for members' travelling and subsistence and members of all the Boards are entitled to recover such expenses where incurred for official purposes. The allowances are also exclusive of any arrangements made by the Boards under which they provide cars and chauffeurs for the use of their members for official business.

Normally, the chairmen of Area Electricity Boards receive a salary of £4,000 and deputy-chairmen £3,500, but the return notes that one chairman and two deputy-chairmen receive the higher salaries they were paid as officers of undertakings absorbed under the Electricity Act, 1947. Members of the Boards (part-time) are paid £500 a year but those appointed before 31st December, 1950, receive £750. Chairmen of Consultative Councils (who are *ex officio* members of their appropriate Area Boards) are paid £750 (or £1,000 if appointed before 31st December, 1950). Each Board receives an annual allowance of £1,500.

AREA BOARDS

The members of the twelve Area Boards are detailed below; the date in parenthesis is that of the expiry of the individual's appointment:—

London.—*Chairman,* Mr. D. B. Irving (30th June, 1959); *deputy-chairman,* Mr. A. N. Todd (31st August, 1959); *members* (*part-time*), Dr. P. Dunsheath (31st December, 1958), Mrs. G. H. Dunbar (31st December, 1958), Mr. G. C. R. Eley (31st December, 1959), Sir George Gater (31st March, 1957), Mr. E. A. Mills 31st December, 1957), and Mr. I. J. Hayward* (30th September, 1958).

South Eastern.—*Chairman,* Mr. N. Elliott (31st December, 1957); *deputy-chairman,* Mr. W. R. T. Skinner (31st December, 1957); *members* (*part-time*), Mr. E. Simms (31st March, 1959), Viscount Falmouth (31st March, 1959), Sir Arthur Howard (31st December, 1957), Sir Giles Loder, Bt. (31st October, 1958), Mr. H. F. Carpenter (31st March, 1959) and Comdr. D. S. E. Thompson* (30th September, 1958).[1]

Southern.—*Chairman,* Mr. R. R. B. Brown (30th November, 1959); *deputy-chairman,* Mr. S. M. Rix (30th November, 1959); *members* (*part-time*), Lt.-Col. E. L. Luce (31st March, 1957), Mr. W. H. Lawson (31st March, 1957), Mr. P. W. Barnes (30th November, 1957), Mr. R. Farquharson (31st December, 1957), Mr. Forbes Jackson (31st July, 1958) and Group Capt. J. C. M. Hay* (30th September, 1959).

South Western.—*Chairman,* Mr. A. N. Irens (28th February, 1961); *deputy-chairman,* Mr. E. C. Willis (31st July, 1959); *members* (*part-time*), Mr. S. H. Payne (31st March, 1958), Mr. H. M. Medland (31st March, 1957), Mr. L. V. Turner (31st May, 1957), Col. T. F. Hood (31st December, 1959), Mr. J. T. Beresford (31st March, 1958), Sir George Turner (30th April, 1959) and Lady C. Carew Pole* (14th August, 1958).

Eastern.—*Chairman,* Mr. C. T. Melling (31st December, 1957); *deputy-chairman,* Mr. H. C. Waters (31st December, 1956); *members* (*part-time*), Sir Cecil Oakes (31st December, 1956),[2] Mr. W. Newcome-Baker (31st March, 1958), Gen. Sir Frank E. W. Simpson (30th April, 1957), Col. Sir Stuart Mallinson (23rd May, 1957), Mr. J. E. N. Davis (28th February, 1958) and Mr. W. J. Bennett* (30th September, 1957).

East Midlands.—*Chairman,* Mr. C. R. King (31st December, 1957); *deputy-chairman,* Mr. J. Mould (31st December, 1957); *members* (*part-time*), Mr. A. Sturgess (31st March, 1957), Mr. G. H. B. Wilson (31st March, 1957), Mr. E. A. C. Woodcock (31st January, 1960), Mr. B. H. Gardner (30th April, 1958), Mr. J. F. Stanier (30th April, 1958), Mr. FitzHerbert Wright (31st March, 1959) and Mr. L. L. Perkins* (30th September, 1957).

Midlands.—*Chairman,* Mr. W. S. Lewis (31st December, 1957); *deputy-chairman,* Mr. D. P. Sayers (28th February, 1959); *members* (*part-time*), Mr. A. E. Bennett (31st December, 1959), Mr. S. F. Burman (31st December, 1959), Mr. C. R. Heathcock (31st March, 1957), Mr. J. McDowall (31st March, 1957), Mr. H. T. Fullwood (31st March, 1957), Mr. R. M. Barrow (28th February, 1959) and the Rev. R. A. Giles* (14th August, 1958).

South Wales.—*Chairman,* Mr. L. Howles (31st December, 1957); *deputy-chairman,* Mr. W. A. Gallon (31st December, 1957); *members* (*part-time*), Mr. T. Evans (31st December, 1959), Mr. B. Curran (31st December, 1958), Mr. R. James (31st December, 1957), Mr. L. Parsons (31st March, 1959), Mr. H. G. Partridge (31st July, 1957), Sir Leighton Seager, Bt. (30th November, 1959) and Mr. G. L. Curnow* (30th September, 1958).

Merseyside and North Wales.—*Chairman,* Mr. D. H. Kendon (7th February, 1959); *deputy-chairman,* Mr. J. Rankin (31st December, 1957); *members* (*part-time*), Mr. J. A. Duncan (31st December, 1958), Sir Geoffrey

* Chairman of Consultative Council.

Summers, Bt. (30th June, 1959), Lt.-Col. J. F. Williams Wynne (31st October, 1959), Mr. H. M. Bibby (30th September, 1958), Mr. C. M. Jones (30th June, 1959) and Mr. H. Evans* (30th September, 1959).[3]

Yorkshire.—*Chairman,* Mr. D. Bellamy (24th February, 1960); *deputy-chairman,* Mr. A. Bond (31st January, 1962); *members (part-time),* Mr. R. E. Crowe (31st March, 1957), Mr. J. C. M. Maclagan (31st May, 1959), Mrs. C. Renton-Taylor (31st October, 1958), Mr. P. Buchanan (31st December, 1957), Mr. J. Foster Beaver (31st May, 1959) and Mr. W. Leach* (30th September, 1957).

North Eastern.—*Chairman,* Mr. T. M. Ayres (30th November, 1959); *deputy-chairman,* Mr. N. F. Marsh (29th February, 1960); *members (part-time),* Col. E. G. Angus (31st March, 1959), Mr. E. T. Judge (31st March, 1958), Major C. L. Baldwin[4] (28th February, 1957), Mr. J. Bowman[4] (31st March, 1957), Mr. E. J. Hunter (30th April, 1958), Col. R. Mould-Graham (31st March, 1959) and Mr. W. S. Hall* (30th September, 1957).

North Western.—*Chairman,* Mr. T. E. Daniel (31st December, 1960); *deputy-chairman,* Mr. T. Coates (31st December, 1960); *members (part-time),* Mr. H. E. Rhodes[5] (31st December, 1956), Miss N. Kenyon (31st December, 1956), Mr. J. R. Potts (31st March, 1958), Mr. E. J. Smith (31st March, 1958), Mr. M. L. Haselden[5] (unpaid) (31st December, 1956), Mr. B. Pickup[5] (31st January, 1957) and Mr. F. Kenyon[6] (30th September, 1958).

SOUTH OF SCOTLAND ELECTRICITY BOARD

The next table shows the membership of the South of Scotland Electricity Board which came into being in 1955.

Position	Name	Salary	Date of expiry of appointment
Chairman	Mr. J. S. Pickles	£5,000	31st December, 1959
Deputy-Chairman	Mr. W. Hutton	£4,250	31st December, 1958
Member (part-time)	Mr. J. Sullivan*	£1,000†	31st December, 1959
,, ,, ,,	Col. J. G. Crabbe	£750	31st December, 1957
,, ,, ,,	Mr. Jackson Millar	£750	31st December, 1957
,, ,, ,,	Sir Ronald J. Thomson	£750	31st December, 1957
,, ,, ,,	Sir John Imrie	£500	31st December, 1959
,, ,, ,,	Mr. I. W. Macdonald	£500	31st December, 1958
,, ,, ,,	Mr. H. Wilkinson	£500	31st December, 1958

* Chairman, Consultative Council.
† A fee of £500 is payable in addition in respect of additional duties.

There is an allowance of up to £1,500 a year for the Board as a whole.

NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD

All the members of the North of Scotland Hydro-Electric Board are part-time. The chairman (the Rt. Hon. Thomas Johnston) and the deputy-chairman (Sir Hugh Mackenzie), whose term of office expires on 31st December, 1957, are both unpaid. Three other members, Sir John Erskine, Sir George T. McGlashan* and Mr. G. R. McIntosh, receive £750 a year and three others, Mr. A. I. Mackenzie, Provost A. Macrae and Mr. A. Duncan Miller are paid £500 a year. The Board as a whole receives an annual allowance of up to £1,500.

Sir John Erskine and Messrs. McIntosh and Mackenzie were due to retire on 31st December but have been reappointed for a further term. Lord Provost W. Hughes was appointed a member as from 1st January.

[1] Sir Albert T. Day was appointed part-time member in December, 1956.
[2] Reappointed January, 1957.
[3] Mr. R. W. Johnson appointed part-time member December, 1956.
[4] Reappointed for further term December, 1956.
[5] Reappointed for further term January, 1957.
[6] Mr. G. A. Howe appointed part-time member in January, 1957.

Railway Electrification in France

HIGHER speeds and extended electrified services in France were among the aspects of progress on the French National Railways reviewed by Monsieur C. M. Hannoyer, general manager of French Railways, Ltd., in London, in a recent lecture to the Railway Students' Association in London. The Dijon-Dôle 1,500 V d.c. electrification extension had been opened on the day of the lecture, and M. Hannoyer remarked that when the sections from Dôle to Vallorbe and Dôle to Pontarlier were electrified next summer, trains would be electrically hauled throughout between Paris and Venice via Lausanne and Milan. Since early 1955, when the Mâcon-Ambérieu section was electrified, there had been continuous electrification from Paris to Palermo in Sicily, a distance of about 1,500 miles.

The 1,500 V d.c. system was being extended down the main line from Lyons towards Avignon and Nîmes, which would permit still faster journeys to the Riviera. Already an electric locomotive hauling a train weighing more than 700 tons had averaged over 86 m.p.h. for the 318 miles between Paris and Lyons with one stop, and next summer the "Mistral" express would be accelerated to average 80 m.p.h. on this part of its journey to Nice. This train was now fully air conditioned, power for the equipment being supplied from diesel-electric plant in a special vehicle.

In dealing with the 25 kV, 50 c/s single-phase system in France, M. Hannoyer reported the opening on 17th December of electrification from Metz to Strasbourg, giving continuous 50 c/s operation between Strasbourg and Lille. In the latter part of 1957 this electrification would reach Basle, and by the end of 1958 the Paris-Lille line would be electrified on the same system.

The latest development in 50 c/s locomotives was a four-axle vehicle weighing only 60 tons as compared with the 83 tons of previous types of the same size. Four years ago the last new steam locomotive for the French National Railways had gone into service, and M. Hannoyer said it was estimated that by the time the last steam locomotive was withdrawn in 1970, just over 25 per cent of the total mileage of the system would be electrified, but would be carrying 80 per cent of the total volume of traffic. At present the electrified mileage amounted to about 12 per cent of the total and was carrying about 40 per cent of the traffic.

At the end of his lecture M. Hannoyer exhibited films showing the French National Railways world rail speed record runs of 1956, and scenes on lines electrified on the 1,500 V d.c. and 25 kV, 50 c/s, single-phase systems. The chair at the meeting was taken by Mr. J. W. Watkins, a member of the British Transport Commission, who is president of the Railway Students' Association.

Non-Ferrous Castings Symposium

THE Institute of Metals, in association with the Institute of British Foundrymen, is holding an all-day symposium on "Metallurgical Aspects of the Control of Quality in Non-Ferrous Castings" at Church House, Great Smith Street, Westminster, London, S.W.1, on 1st May. The eight papers contributed to this symposium will be presented by a rapporteur (Dr. W. A. Baker, research manager of the British Non-Ferrous Metals Research Association). Tickets are not required, but non-members are asked to advise the secretary of the Institute of Metals, 17, Belgrave Square, London, S.W.1, of their intention to be present.

The autumn meeting of the Institute of Metals will be held in Glasgow from 17th to 20th September next by invitation of the Scottish Local Section.

VIEWS on the NEWS

By REFLECTOR

A REMINDER comes from the Eastern Electricity Board that it was at Norwich that the first two-part tariff for domestic consumers was introduced half a century ago. At that time the flat rate was 4½d/kWh but Mr. F. M. Long, then city electrical engineer, realised that something would have to be done if the use of electricity was to be encouraged. He therefore conceived the idea of instituting a standard charge amounting to 12½ per cent of the consumer's rateable value (to include the meter rent) and charging 1d/kWh for all electricity consumed. He expected this to result in an immediate decrease in revenue to be recovered when electricity became more popular as a result of the new tariff. Actually the fall in the succeeding twelve months was only £370 against the decrease of £880 anticipated because sales to the 251 private consumers rose by 22 per cent. Even to-day this method of charging is referred to in some parts of the country as the "Norwich system."

* * *

According to the *Daily Herald* in a report upon the Barony power station, Ayrshire, which is to burn slurry taken from an adjacent colliery, "enough power to supply both Perth and Dumfries will be produced every day by the dust-driven dynamos." I rather like this alliterative description however wrong it may be. The paper goes on to say that Barony will be the first power station to generate electricity from "rubbish." That is untrue, of course. Apart from the dust destructor generating plants which were in operation years ago (are they still running?) there is the Tir John plant in South Wales which was designed to take anthracite duff from local collieries—and anthracite duff was then regarded as rubbish, whatever is thought of it now.

* * *

Electrical men who try to book accommodation at hotels in certain seaside towns during the May-June conference season know how difficult it is. As I have had the experience myself I was wryly amused at a passage in "Italy for Beginners" (Wingate) a book by George Mikes which I have just been reading. The author asks:—

> "Why are Italian hotels full all the time? Because of the engineers' conferences. We could not get a room in Verona because—we were told—the engineers were having a conference in the town. We could not get a room in Padua because the same engineers—or perhaps other engineers—were having another conference there too. . . . In no travel guide is this basic fact mentioned that engineers are having a conference in all Italian towns all the time."

* * *

Electricians of the South Western Electricity Board investigating a consumer's complaint that television reception had been spoilt following installation work carried out in the house, traced the trouble to a peculiar cause. Writing in the Board's magazine, Mr. K. Fear, chargehand electrician, says that, after floor boards had been lifted and cables checked without avail, it was eventually found that the interference was caused by the pendulum of a grandfather clock, removal of which effected a permanent cure. Apparently the pendulum, being approximately a quarter wavelength long at TV frequency, was acting as a small transmitter. I hope the consumer was persuaded to buy an electric clock.

* * *

At Turriff (Aberdeenshire) the Commercial Bank of Scotland "gifted" a piece of land adjoining its local branch to the local Council for a road-widening scheme. The *Press and Journal* (Aberdeen) says that the Bank was shocked when it found that the Council proposed to erect a public convenience on the site. The North of Scotland Hydro-Electric Board seems to share this feeling for it has not replied to a suggestion by the Council that it might incorporate a "sub-power station" on the corner of the site. In the meantime the Council's decision has caused much local division—reminiscent of "Clochemerle" over a rather similar subject.

* * *

Sir Lawrence Bragg, writing to *The Times*, complains that too often scientists are not allowed to get on with their real job. Too much of their energy, especially that of the leading experts, is being frittered away on duties and responsibilities where their professional gifts play little part, he says. Committees are said to be the worst time wasters. As an example of what he means (and incidentally of the attitude of mind of many people towards scientists) Sir Lawrence says:—

> "I remember vividly an occasion when I wished to consult a colleague about an administrative matter and got this revealing reply from his secretary: 'I am sorry, Dr. — is not in the laboratory to-day, he is working.'"

* * *

There was great activity in connection with the comparatively new electric light seventy years ago. The issue of the *Electrical Review* dated 14th January, 1887, reported a number of interesting developments. There was a description of the newly-installed lighting system at Olympia, London. For this four dynamos, "each of 40 units," two 200 h.p. compound steam engines and three 200 h.p. boilers were provided. There were 1,000 glow lamps of 17 candle power and 62 arc lamps. Particulars were also given of the proposed electric lighting of the Pavilion and Dome at Brighton. A 40 h.p. engine-driven generating set was suggested. It was said that this would be sufficient to supply 600 lamps but it was thought that only 400 should be installed and the surplus power used to charge a secondary battery for standby use. Another item reported that

> "MM. de Lesseps and Stokes have been making experimental trips by night to various portions of the Suez Canal with the electric light and in a few days the whole of the canal will be opened for night traffic by the aid of the electric light, thus shortening the passage through by twenty-four hours."

PERSONAL AND SOCIAL

News of Men and Women of the Industry

The British Thomson-Houston Co., Ltd., announces that **Mr. W. Spence,** B.Sc., M.I.E.E., A.M.I.Mech.E., has been appointed manager of the Industrial Engineering Department in succession to **Mr. W. J. Pool,** B.Sc., A.M.I.E.E., who has relinquished the appointment in order to devote his full time to special duties with the company.

Mr. Pool joined the B.T.H. Co. in the Test Department at Rugby in 1914 after graduating at Birmingham University. He joined the industrial engineering staff in 1919 and in 1941 succeeded the late Mr. R. D. Given

Mr. W. Spence

Mr. W. J. Pool

as manager of the Industrial Engineering Department. Recently Mr. Pool has studied problems associated with nuclear power projects, and it is to enable him to give his full time to such projects that he has relinquished the managership of the department.

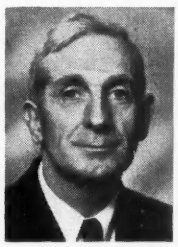
Mr. Spence was educated in Scotland, first at Kirkcaldy High School and afterwards at the University of Edinburgh. He joined the B.T.H. Co. as a student apprentice in 1937 (having previously spent two periods with the company as a vacation apprentice). In 1939, as a member of the Territorial Army, he commenced service with the 271st Field Battery, R.A., and served in France and Belgium. He was commissioned in July, 1940, and was subsequently appointed instructor in A.A. Fire Control (Radar) in 1941. Later, as a captain in the R.E.M.E., he was lecturer in electrical engineering and fire control instruments at the Military College of Science from 1943 to 1946. Returning to civil life, Mr. Spence rejoined the B.T.H. Co. as a member of the industrial engineering staff and in 1947 was awarded a B.T.H. Fellowship which enabled him to spend a year in the United States with the General Electric Co., where he worked on high-speed tandem cold strip mills and electronic sectional paper-machine drives. He rejoined the Industrial Engineering Department in 1948 and was appointed section leader of the electrical development section; three years later he became assistant manager of the department.

The British Transport Commission has appointed **Mr. G. H. Hinds,** O.B.E. (formerly Director of Weapons Research, Ministry of Supply), as electronics advisory officer to the Commission. The appointments of Mr. Hinds, and of an Electronics Advisory Panel of B.T.C. officers in conjunction with whom he will work, have been made in order to foster progress in the use of electronic computers throughout the Commission's undertakings, and to keep abreast of electronic research and developments elsewhere.

Lt.-Col. L. A. M. Bates-Oldham has been appointed a special director of International Combustion, Ltd.

Black & Decker, Ltd., announce that **Mr. L. Long** has been appointed European sales manager and is succeeded as regional sales manager (utility) for the London and Eastern region of England by **Mr. W. Downing. Mr. K. Gahagan** has been appointed mid-African representative; until recently he was the company's Middle East representative.

Mr. H. de B. Knight, M.Sc., M.I.E.E., F.Inst.P., who writes in this issue on the present state of knowledge with regard to problems involved in arc control, studied electrical engineering at Manchester University. After three years' military service in the first world war he served his student apprenticeship with the British Thomson-Houston Co., Ltd., Rugby, and joined the staff of the research laboratory in 1925. He was engaged in the study of vacuum physics and gas discharges, with particular reference to high power mercury arc rectifiers, subsequently specialising in research, design and engineering problems of control valves such as thyratrons and ignitrons. During the second world war he was responsible for the development of special thyratrons which were used extensively as modulator valves in radar. Mr. Knight is now head of the Electronic Valves Section of the B.T.H. Research Laboratory.



Mr. H. de B. Knight

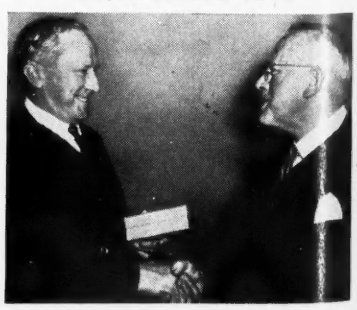
Queen Elizabeth, the Queen Mother, as Chancellor of London University, attended the president of the Union's dinner and ball held at the Senate House recently. In the accompanying picture the Queen Mother is shown with Mr. R. Harris, president of the University Students' Union, who is an engineering degree student with Johnson & Phillips, Ltd.

Queen Elizabeth, the Queen Mother, with Mr. R. Harris at the dinner and ball of the London University Students' Union

To permit more attention to forward policy rather than day-to-day administration, **Mr. J. W. C. Milligan** has relinquished the appointment of managing director of P.A.M., Ltd., in favour of **Mr. S. R. Elliott,** A.M.I.P.E. Mr. Milligan, who is managing director of the Southern Areas Electric Corporation, Ltd., which controls P.A.M., Ltd., remains on the board of the latter company.

Mr. M. Smith, an executive director of Oldham & Son, Ltd., retired on 31st December. He had been with the company for thirty-five years. Mr. Smith joined the company as an engineer in 1921, but later became concerned with the expanding market for radio and automobile batteries. As service station manager he did much to develop the Oldham service station organisation in pre-war years. After

Mr. M. Smith (left) receiving a presentation from Mr. S. J. Wrigglesworth on his retirement from Oldham & Son, Ltd.



the war Mr. Smith was made an executive director of the company with special responsibilities for liaison between sales, research and production departments. He was also responsible for the co-ordination of all Oldham publicity campaigns. Mr. Smith recently received a presentation from Mr. S. J. Wrigglesworth, director and general manager, to mark his retirement.

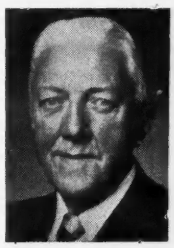
Mr. H. C. Elsden has been appointed to the board of Ross, Courtney & Co., Ltd., a subsidiary of the Southern Areas Electric Corporation, Ltd. Mr. Elsden has been general manager of the company for seven years.

To commemorate his fifty years' membership of the American Society of Mechanical Engineers, **Mr. G. M. Campbell** was on 2nd January presented with the Society's medal. The presentation, which took place at the B.T.H. Rugby works (where Mr. Campbell was director of manufacture until he retired in 1946), was made on behalf of the American Society by Colonel P. H. Jones, chairman of the

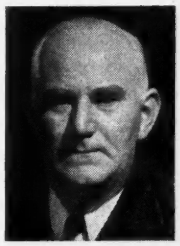
Mr. G. M. Campbell (left) receiving the medal of the American Society of Mechanical Engineers from Col. P. H. Jones

Midland Branch of the Institution of Mechanical Engineers (Gt. Britain). At the ceremony were Mr. K. R. Hopkirk (director and chief mechanical engineer, B.T.H.) and members of the Rugby panel of the Institution of Mechanical Engineers.

The Automatic Telephone & Electric Co., Ltd., announces that **Sir Alexander Roger,** K.C.I.E., has retired from the board with effect from 31st December, 1956, and has accepted the appointment of honorary president of the company. Some thirty-five years ago Sir Alexander Roger became a director of both the International Automatic Telephone Co., Ltd., and the Automatic Telephone Manufacturing Co., Ltd., which were subsequently merged into the present company. He was responsible for the negotiations with the British Post Office which resulted in the adoption of the Strowger system of automatic telephony as the standard British Post Office system. Sir Alexander Roger has been succeeded as chairman of the company by **Sir Thomas Eades,** who has been managing director for the past twenty years, and **Mr. C. O. Boyse** has been appointed managing director.



Sir Alexander Roger



Sir Thomas Eades

Mr. C. O. Boyse

Mr. H. F. Tremlett, A.R.S.M., B.Sc., F.I.M., M.I.S.I., has been appointed deputy director of the British Welding Research Association. He takes up his appointment at the Abington Research Station on 1st February. Mr. Tremlett attended the Royal School of Mines, London, between 1928 and 1932 and obtained an Associateship in Metallurgy and B.Sc. degree. In 1932 he joined the United Steel Co. as a graduate apprentice and entered the Siemens Melting Department of Samuel Fox & Co. in 1934. He was transferred to the Central Research Department in 1935 and became head of the Welding Section on its formation. Mr. Tremlett is a member of several B.S.I. and Institute of Welding technical committees and has served for a number of years on various committees of B.W.R.A. He is the joint British representative on Commission No. 9 of the International Institute of Welding and has written many articles on the metallurgy of welding.

We refer in our "Industrial News" section to the formation of a new Siemens Edison Swan Export Co. The members of the board are as follows:—**Dr. J. N. Aldington** (chairman), **Mr. J. S. A. Bunting, Mr. B. A. Hensler** (managing director), **Mr. W. G. Patterson** and **Mr. J. W. Ridgeway.**

The directors of Muirhead & Co., Ltd., entertained **Mr. F. J. Pickard,** assistant commercial manager, to lunch on 28th December to celebrate his completion of fifty years' service with the company. In the evening Mr. Pickard with his colleagues of the executive staff and their wives were given a dinner at the Waldorf Hotel, Mr. J. V. Foll, O.B.E., managing director, Mrs. Foll, Mr. J. D. Twinberrow, director and secretary, and Mrs. Twinberrow also being present. The company afterwards visited Drury Lane Theatre.

Mr. E. Bruce Ball has resigned from the board of Metal Industries, Ltd., and from the boards of all subsidiary companies of which he was a director.

Mr. J. F. Richardson has been appointed technical secretary of the Radio Communication and Electronic Engineering Association. He will work under Mr. H. E. F. Taylor, whose appointment as executive secretary of the Association was announced recently. Since 1952 Mr. Richardson has been technical assistant to the director of the Electric Lamp Manufacturers' Association where he was largely responsible for the technical work and was acting secretary to the technical committees concerned with lamp specifications. Before that, from 1947, he was with the London Transport Executive as a technical assistant in the Signal Engineer's Office, Earls Court.

Mr. J. F. Richardson

Mr. Richardson received engineering training with Standard Telephones & Cables, Ltd., North Woolwich. He

Dr. J. N. Aldington

Mr. J. S. A. Bunting

Mr. B. A. Hensler

Mr. W. G. Patterson

Mr. J. W. Ridgeway

studied electrical engineering at Leicester College of Arts and Technology.

On the retirement of **Mr. G. W. Preston,** M.B.E., M.I.E.E., for health reasons as general manager, **Mr. R. B. F. Wylie,** B.A.(Cantab.), B.L., LL.B., has been appointed to the new position of director of the Copper Development Association, whose headquarters are now at 55, South Audley Street, London, W.1.

Mr. Preston joined the C.D.A. as its electrical engineer when the Association was formed in 1933, and succeeded Mr. D. P. C. Neave as general manager in 1938. During the last war he was seconded to the non-ferrous metals control section of the Ministry of Supply, and his services were recognised with the M.B.E. in 1945.

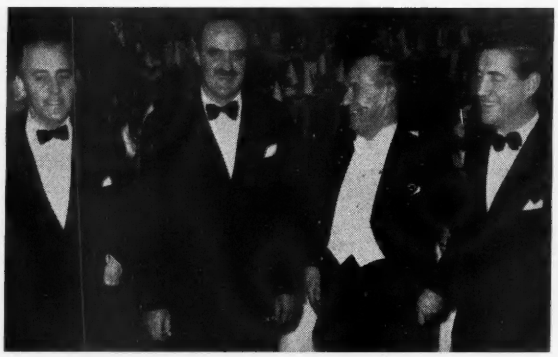
His successor, Mr. Wylie, comes of a family well known in Glasgow business circles. He was educated at Shrewsbury School and Clare College, Cambridge, where he studied economics and law, and also gained his "Blue" in rowing. He served in the Royal Navy during the war, attaining the rank of lieut.-commander, R.N.V.R.

In our last issue we reported the appointment of **Mr. H. G. Taylor,** D.Sc. (Eng.), D.I.C., M.I.E.E., F.Inst.P., as director of the Electrical Research Association with effect from 1st April next. We now reproduce his portrait herewith.

Dr. H. G. Taylor

Mr. J. E. Oram, hitherto director and general manager of Wild-Barfield Electric Furnaces, Ltd., has been appointed managing director of the company.

Some 150 members and friends attended the annual dinner and dance of the West London Branch of the **Association of Supervising Electrical Engineers** held at the Clarendon Restaurant, Hammersmith, last Saturday. The toast of "The Ladies" was proposed by Mr. E. A. Bromfield, the general secretary, Mr. J. Flood responding. "The West London Branch" was proposed by Sir Harold Bishop, president of the Association, who paid a tribute to the Branch's fine record, mentioning the large number of national chairmen who had come from the Branch.



At the A.S.E.E. West London Branch dinner and dance. Left to right: Mr. E. A. Bromfield (general secretary), Sir Harold Bishop (president), Mr. J. H. K. Pendry (Branch chairman) and Mr. N. G. O'Hara (Branch secretary)

Mr. J. M. Brooke, M.I.Mar.E., managing director of the Venner group of companies, is leaving this country on 12th January to investigate the possibility of setting up a company to manufacture Venner products in Australia. Mr. Brooke will fly out by the North Pole route, reaching Sydney on 16th January, where he will stay with H. Rowe & Co. (Pty.), Ltd., the Venner distributors who will be assisting in the investigations. Following a visit to Jas. J. Niven & Co., distributors for New Zealand, Mr. Brooke will return by air *via* New York and is expected back in London at the beginning of March.

Mr. J. M. Brooke

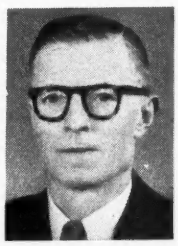
Mr. N. M. Hill, M.I.E.E., district manager, Midland area, with the General Electric Co., Ltd., since 1946, has retired after 42 years' service with the company. He is succeeded by **Mr. R. H. Phillips,** who has been assistant district manager since 1949. **Mr. P. L. P. Thomas,** formerly manager of the G.E.C. Hull branch, has been appointed assistant district manager, Midland area.

Mr. Hill was one of the earliest G.E.C. apprentices at the Witton Works, Birmingham, serving a year there in 1904 while he was articled to a Birmingham consulting engineer. In 1910 he went to the United States for four years on construction work with Western Electric and General Electric. After the first world war, in which he served with the R.F.C., he joined the G.E.C. in Liverpool as branch engineer, transferring to Manchester in 1923 and becoming assistant branch manager in Birmingham in 1927. Mr. Hill became a member of the Committee of the I.E.E. South Midlands Centre in 1941. He is a past-president of the Birmingham Electric Club and in 1954 was elected president of the Midland Electrical Engineers' Association.

Mr. Phillips, Associate I.E.E., joined the G.E.C. Witton works in 1926, later transferring to the Birmingham branch and becoming manager of the Installation Materials' Department in 1939. After war service with the Royal Engineers and Royal Artillery he was appointed manager of the G.E.C. Leicester branch. In 1949 he became assistant district manager, Midland area. He is joint hon. secretary of the Midland Electrical Engineers' Association, and a member of the Council of Birmingham Electric Club.

Mr. J. Eccles, deputy chairman (operation) of the Central Electricity Authority, was the guest speaker at last Tuesday's luncheon of the **Electrical Industries Club.** He gave a succinct account of the present and future power position in this country and spoke appreciatively of the plant manufacturers' co-operation with the C.E.A. Mr. Eccles was introduced by the president, Mr. Leslie Gamage, who congratulated him on his recent knighthood, and a vote of thanks was proposed by Mr. T. W. Heather. Sir Charles Westlake will be the speaker at the next luncheon which takes place on 12th February.

In addition to the names of electrical men who received awards in the New Year Honours List, given in our last issue, **Mr. A. Collins,** B.Sc., M.I.E.E., of the Micanite & Insulators Co., Ltd., was awarded the M.B.E.



Mr. A. Collins

In the list of those awarded the O.B.E. we mentioned **Mr. J. Nadin,** whom we described as general manager and director of the D.P. Battery Co., Ltd. We are now informed that he was appointed chairman of the company last month.

Mr. E. W. Semmens, A.M.I.E.E., has been appointed assistant managing director of Nalder Bros. & Thompson.

Mr. J. B. Carroll, M.Sc., A.I.M., whose article on "Modern Electric Heat Treatment Furnaces" appears in this issue, graduated in metallurgy in 1944 from Manchester University. He then joined Frederick Smith & Sons, copper wire manufacturers, as assistant metallurgist. Mr. Carroll returned to Manchester University in 1946 for two years' research on wire drawing and was awarded his M.Sc. degree for

Mr. J. B. Carroll

this work. In 1948 he joined Birlec, Limited, as assistant metallurgist and was appointed chief metallurgist in 1955.

OBITUARY

Mr. A. M. Scales.—The death occurred on 3rd January, at the age of seventy, of Mr. Alfred Moreton Scales, who retired on 31st October after nine years with the Atlas Lighting Division of Thorn Electrical Industries, Ltd. Whilst with the company he was in charge of the lamp sales-policy section and he was closely associated with the Social and Sports Club. He served with the Army in India, Mesopotamia and Afghanistan, attaining the rank of major. On leaving the Army in 1922 he concerned himself with the manufacture and distribution of electric lamps, and in 1925 was associated with "Kye" lamps and was later proprietor of "Lunar" and "Spero" lamps.

The late Mr. A. M. Scales

Mr. T. Y. Dobson, O.B.E., V.R.D., a director of Davis & Timmins, Ltd., died on 19th December at the age of seventy-three after a short illness. Mr. Dobson joined the associate company, D. Gilson & Sons, Ltd., in 1909, and was elected to the board of the parent company in 1928, on the amalgamation. He was appointed joint managing director in 1946, a position he occupied until he retired in 1952.

Mr. S. H. B. Langlands, J.P., F.I.E.S., who died on 4th January at the age of eighty-five, was for many years, until his retirement in 1936, inspector of lighting at Glasgow. He was a founder member and first president of the Association of Public Lighting Engineers and served a second term as president in 1929. In 1936 he was made an honorary member of the Association. He was a member of the Illuminating Engineering Society from 1911 and held office as vice-president from 1935 to 1938.

Mr. F. P. Wainwright.—The death occurred on 2nd January of Mr. Frederick Pearson Wainwright who, until he retired in 1954, had been on the staff of the British Thomson-Houston Co., Ltd., for 42 years, the last 22 at the company's Birmingham office.

Mr. R. J. Wood, assistant sales manager of the E.M.I. Recording Equipment Division, died on 1st January at the age of forty-four, after a long illness. Mr. Wood joined the company before the war and on his return in 1945 was appointed television service manager. He became assistant sales manager of the Recording Equipment Division on its formation in March, 1953.

Mr. A. L. Boyle.—The death occurred recently, at the age of 84, of Mr. Arthur Leonard Boyle, A.M.I.E.E., who was borough electrical engineer of Scunthorpe, Lincs., for about 25 years. He retired in 1946.

Mr. W. S. Gearing.—The death occurred on 5th January, at the age of fifty-six, of Mr. W. S. Gearing, M.I.E.E., London branch manager for Johnson & Phillips, Ltd. Mr. Gearing was trained at the works of Crompton & Co., Chelmsford, and served as a sales engineer with that company and with Crompton Parkinson, Ltd., after the amalgamation. In 1933 he joined the Watford Electric Co., Ltd., and Whipp & Bourne, Ltd., who were jointly represented in London at that time. In 1936 he became senior sales engineer at the J. & P. London branch and was appointed branch manager in 1948.

The late Mr. W. S. Gearing

The Late Dame Caroline Haslett

WE have to report with great regret the death of Dame Caroline Haslett on Friday last after a long illness which had already compelled her to relinquish her public activities.

Caroline Harriet Haslett was born at Worth, Sussex, in 1895, and after education at Haywards Heath joined the Cochran Boiler Co. during the first world war, and acquired an engineering training. She then began the activities on behalf of women which continued throughout her life by becoming the first secretary of the Women's Engineering Society and editor of its journal. She was president of the Society from 1939 to 1941.

The late Dame Caroline Haslett

Her interest turned toward electrical matters and she became in 1924 the first director of the Electrical Association for Women of which she was the founder with the assistance of the late Mr. J. W. Beauchamp (director of E.D.A.), Mr. L. L. Robinson (Hackney), Sir Charles Parsons, Sir Alfred Yarrow and Mr. R. Borlase Matthews. Miss Haslett, as she then was, aroused great interest among a number of women's organisations, town planning authorities and other bodies likely to assist in the movement and once the Association got going branches were formed all over the country. As a result there are now about 160 branches with a total membership of 14,000. Through its propaganda and educational activities the E.A.W. has played a tremendous part in the electrification of homes and remains as a monument to Caroline Haslett's initiative and her remarkable ability to impart her enthusiasm to others. She was chairman of the E.D.A. Council in 1953-54 and later a vice-president.

Her other main electrical achievement was her appointment as a member of the British Electricity Authority upon its establishment in 1947—an appointment which secured approval in view of the importance of domestic electrical development. Ill-health prevented her reappointment when her term expired last year.

In addition to her work on behalf of the electrical industry Caroline Haslett was active for many years in a number of other directions. She had served as a Council member of the British Institute of Management and of the Industrial Welfare Society, vice-president of the Royal Society of Arts, and president of the British and Internation Federation of Business and Professional Women. She was also a member of the Crawley (Sussex) Development Corporation. In the educational sphere she was a member of the governing bodies of the London School of Economics, Queen Elizabeth College, Bedford College for Women, the Administrative Staff College, etc.

During the 1939-45 war Miss Haslett acted as adviser on woman power to the Ministry of Labour and in that capacity visited the United States and Canada and she also paid visits to Sweden, Finland and the Middle East.

In recognition of her work for women she was made a Commander of the Order of the British Empire in 1931 and in 1947 she was promoted to Dame Commander. The Institution of Electrical Engineers elected her a companion in 1932 and she had been a J.P. for the County of London since 1950.

The funeral took place privately at Bungay, Suffolk, where Dame Caroline lived with her sister, Mrs. R. Messenger. A memorial service is to be held later.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Too Many Institutions?

I NOTICED in your paper the other day a reference to the formation of yet another institute or institution. There are many arguments for and against the formation of new professional bodies, and quite obviously no generalisation can be made—the desirability or otherwise of a new body is a matter to be considered in relation to the circumstances of each case. However, I must point out that, whereas a more general body can sometimes provide a useful forum for discussion among men with a wide range of interests, a danger attaches to the formation of a body, membership of which is restricted to those who have passed, or are exempted from, its own examinations.

My object in writing this letter is particularly to draw attention to the effect which such bodies may have on a man's career. It sometimes happens that a man—not necessarily a young man—who wishes to progress in his career does not know where to obtain advice on the courses of study which he should take. He may receive a brochure of, for example, a correspondence college, and may embark on a lengthy course of study, demanding considerable concentration, effort and sacrifice, to find at the end of it that he has not only followed an inferior study course but has obtained an inferior qualification. Possibly his examination syllabus may have been drawn up by people who are not sufficiently versed in educational methods and practice. Yet this same man, given the right advice, might have followed a properly organised course of study leading to an external or, if he is lucky enough to live in London, internal university degree, B.A. or B.Sc., or qualifying him for membership of one of the recognised institutions. And this he might have achieved in the same period of time, and without very much greater expenditure of effort.

I feel that this is a matter of the gravest public concern, and that the remedy deserves our most serious consideration. That something must be done, and done quickly, I think cannot be questioned.

London, W.C.2. L. LANDON GOODMAN.

Meter Readings

AT the risk of being completely wrong, I venture the opinion that Mr. Shears, who contributed the above-named article to your 14th December issue, can have had very little direct experience of meter reading problems. His article is typically that of the newcomer who, having formed hasty judgment, proposes revolutionary methods which old hands at the game considered years ago, and which they realised were either impracticable or unsatisfactory.

How many more meters does Mr. Shears think would be read per man-day if his camera were employed? Does Mr. Shears realise what a small fraction of time per reading is actually spent in reading and writing the figures, remembering the time spent in getting from house to house, and the increasing number of non-access calls? How long would it take, and how much would it cost, to bring the consumer's reference number within camera range and focus for the 14 million or so meters in the country?

The fundamental problem of meter readings in this country to-day is that a large and increasing number of consumers work during the same hours as the meter readers. This can be solved in two ways. Access could be obtained at the right time (with or without a camera or equivalent device) by the meter readers working different hours from the consumers, and in this connection it is worth noting that at least one pre-vesting undertaking successfully had its meters read in the evenings by pensioners or other suitable people. The alternative is technical and expensive, but is becoming increasingly more feasible, and that is to impulse from the meters over the mains into repeaters in the transformer chambers, whence at reading times, the repeater readings could be automatically transferred to punched tape capable of direct use in the accounting computing machines. In either case, the many advantages and economies which the Americans find to stem from monthly billing would then be possible.

Whilst the use of outdoor meters may be a partial solution where this is possible, there are very large sections of urban areas where such a course would be manifestly prohibitively expensive, even if physically feasible.

Reigate, Surrey. H. S. PETCH.

L.T.E. Power Engineers

THE recent ban on overtime and upgrading now being carried out in the generating stations, substation control rooms, etc., of the London Transport Executive, by supervisory grades and given some prominence, with possibly misleading information, in the national Press, may also mislead our many friends in the electricity supply industry.

This ban, unethical though it may seem, has been forced upon these grades by many years of persistent refusal by the L.T.E. to even approach the salaries and conditions enjoyed by similar grades in the C.E.A.

In the case of manual grades, the L.T.E. are, for obvious reasons, most careful to pay N.J.I.C. awards as and when they become due, whereas, and particularly in the case of control room grades, they will offer a paltry £15 per annum to men whose salaries are anything between £100 and £140 per annum below like grades in the C.E.A.

Without yet making reference to the deplorably poor conditions when compared with, say, the N.J.B. schedule, I should like it made clear that these grades are not "asking for the moon." Their one wish is for salaries and conditions of working similar to those enjoyed by their counterparts in our only comparable nationalised industry—the C.E.A.

"ONE OF THEM."

South of Scotland Electricity Act

THE South of Scotland Electricity Board claims that the South of Scotland Electricity Order Confirmation Act, which received the Royal Assent in November last, is the first attempt made by any Electricity Board "to tidy up the chaos of local legislation inherited from the former supply authorities." The aim of the Act is to repeal local enactments which have been superseded by subsequent legislation; to extend certain other local enactments to the South of Scotland District as a whole; to consolidate some provisions of local enactments with necessary amendments to secure a uniform code throughout the District; and to confer certain additional powers on the Board. The Act covers a wide variety of matters.

INDUSTRIAL NEWS

Overtime Ban

In support of a claim for increased pay, about 200 supervisors employed in London Transport's electrical generating and distribution sections started an unofficial overtime ban last week. The four unions to which they belong are claiming additional pay similar to the shift allowances paid to comparable workers by the Central Electricity Authority. An increase of £20 in the men's basic salaries has been offered by the London Transport Executive.

Diesel-Electric Locos for Australia

The English Electric Co., Ltd., has been awarded a contract to supply seven 750 h.p. diesel-electric locomotives to the Midlands Railways of Western Australia. The diesel engines and electrical equipment for these locomotives will be built at the Preston Works, and the mechanical parts will be manufactured at the company's Rocklea Works in Australia.

Factory Equipment Exhibition

The fifth Factory Equipment Exhibition, which will be held at Earls Court from 29th April to 4th May, will display the products and services of some 300 manufacturers, a number of them from overseas. The British Productivity Council, which is exhibiting, is organising a three-day conference at Earls Court and other professional bodies holding conferences during the Exhibition are the Incorporated Plant Engineers and the Institute of Materials Handling. The theme of the Exhibition is "Greater Efficiency in Industry," and exhibits will include electronic control instruments for a great variety of industrial purposes. Organisations represented in the Exhibition include the British Electrical Development Association.

Measurement of Quality

The Society of Instrument Technology is holding a conference on "Automatic Measurement of Quality in Process Plants" from 23rd to 26th September at University College, Swansea. The meeting will be organised on lines similar to the 1956 Cambridge Conference of the Society. Further details concerning the programme and membership will be published with the March issue of the *Transactions* of the Society.

Fatal Shock from Cleaner

A vacuum cleaner which was being used as a hair dryer was stated to have caused the death of a 15-year-old girl, Patricia Adamson, on whom an inquest was held at Chorley, Lancs., last week. Mr. J. A. Christie, of the North Western Electricity Board, said that a fault had been found on the cleaner and anyone holding a metal part would receive a severe shock. If the machine had been in good order it would be all right to use it as a hair dryer. A verdict of "Death by misadventure" was recorded.

T.V. Camera for Calder Hall

A special television camera has been designed and manufactured to enable engineers at Calder Hall to carry out extremely complicated inspection inside the pressure vessel of the reactor. The new camera has been reduced to under 3in in diameter and 24in in length, so that it can form part of a mechanical grab which will be lowered into the fuel channels of the graphite core to remove possible obstructions. The focus for this particular camera, which carries its own source of illumination, is pre-set to the fingers of the mechanical grab before it is inserted in the reactor. For the purpose of obtaining the fullest information on the behaviour of fuel rods, which supply the heat for the power station, it has been found that television provides the most effective method of routine internal inspection. The new camera is one of a range of more than half a dozen television cameras of different shapes and sizes which Pye, Ltd., has manufactured for special uses in industry. They vary from cameras with dust, heat and waterproof cases to units with remote lens changing and remote pan and tilt attachments.

Electric Heating for Clinics

Lancashire Education Committee has approved the installation of electrical heating systems in place of central heating at the Poulton-le-Fylde, Padgate, Crompton, Great Harwood and Penwortham School Clinics and Child Welfare Centres included in the minor works building programme, 1956-57, at an estimated cost of £7,790 per clinic.

New Siemens Ediswan Company

The Siemens Edison Swan organisation announces the formation as from 1st January of Siemens Edison Swan (Export), Ltd. Formed to give assistance towards an effective export trading relationship to overseas customers, agents and subsidiary companies within the organisation, the new company will deal with the export of both Siemens Brothers and Edison Swan products.

Area managers have been appointed to visit customers and agents within the territories for which they have been made responsible, and an area representative's office will shortly be established in Baghdad where the local resident manager will maintain contact in the Middle East. Further area representatives' offices are to be established in the near future.

The Export Co. will have a Shipping Section and a general section will be responsible for dealing with inquiries and orders affecting more than one product division of the group. Publicity requirements, market surveys and special commissions will also be dealt with by this section. The members of the board of the new company, with their portraits, are given in our "Personal and Social" section. The registered office of the company is Caxton House, Tothill Street, Westminster, London, S.W.1 (telephone: Whitehall 2461).

Cooker for Blind Tenant

When the 1,000th tenant of the Westminster City Council's flats at the Churchill Gardens Estate, Pimlico, moved in last Tuesday she was presented by the London Electricity Board with a new electric cooker. This had been specially adapted by the G.E.C. as the tenant is a blind person. The key of the flat was handed over by the Mayor of Westminster.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £197 0s 0d
COPPER, H.C. Electro	ton £270 0s 0d
Fire Refined 99·70%	ton £269 0s 0d
Fire Refined 99·50%	ton £268 0s 0d
COPPER Tubes ..	lb 2s 7½d
Sheet	ton £300 5s 0d
H.C. wire and strip ..	ton £316 15s 0d
LEAD, English ..	ton £117 0s 0d
Foreign	ton £116 0s 0d
MERCURY	flask £84 0s 0d
TIN, block (English) ..	ton £780 0s 0d
ZINC, G.O.B. Foreign	ton £101 5s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 2½d
Sheet	ton —
Wire	lb 2s 10½d
PHOSPHOR BRONZE Wire	lb 4s 3½d
PLATINUM	oz £34 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 29½d-30d

British Oxygen Co. Criticised

Last week H.M. Stationery Office published the report of the Monopolies and Restrictive Practices Commission on the supply of certain industrial and medical gases (price 6s). In the report the Commission says that it found that the British Oxygen Co., Ltd., and its subsidiaries accounted for nearly the whole of the supply in the United Kingdom of oxygen and dissolved acetylene. It alleges that the company has pursued a policy designed to maintain its monopoly and its prices

are discriminatory and too high and recommends that the Board of Trade, or other competent authority, should make periodical reviews to ensure that effect was given to the Commission's recommendations.

The British Oxygen Co., in a statement made after the publication of the report, says that the Commission comments favourably on the general efficiency of the company and found no evidence that the company's costs are too high. The company maintains that its earnings have been no more than sufficient to enable it to procure capital for development in the open market.

Atomic Power Stations

With reference to the recent announcement of the formation of a new group (Atomic Power Constructions, Ltd.) by Richardsons Westgarth & Co., Ltd., International Combustion (Holdings), Ltd., and Crompton Parkinson, Ltd., we are now informed that the building, civil engineering and structural work will be undertaken by Trollope & Colls, Ltd., in association with Holland & Hannen and Cubitts, Ltd.

Modern Lighting at York Station

As part of the British Transport Commission's modernisation plan, a new lighting installation has been completed at York Railway Station and was recently switched on by the Lord Mayor (Alderman V. A. Bosworth). Cold cathode fluorescent tubes are used and the resultant lighting is good enough to enable newspapers to be read in almost any part of the station to which passengers have access. Although the illumination is many times greater than with the former gas lamps, it is estimated that there will be an annual saving in the cost of power and maintenance of £1,236.

The main platforms, portico and concourse are equipped with spherical shaped "Hilite" fittings while the platforms covered by low awnings have 8ft tubular fittings ("Trilite" or "Bilite"). On the uncovered parts of the platforms post-top cold cathode lanterns are mounted on concrete pillars. The total lighting load is 120 kVA. The fittings were manufactured by the General Electric Co., Ltd., and Ionlite, Ltd., and the installation work was carried out by S. H. Heywood & Co., Ltd.

Cold cathode lighting in York Station

Torquay Convention Proceedings

The full proceedings of the eighth British Electrical Power Convention held at Torquay last May are now available. They cover the presidential address by Sir John Dalton, the ten papers and discussions, the annual dinner and the "Electrical Forum." Full lists are given of the Council membership and of the delegates and visitors. Copies can be obtained from Mr. J. W. Simpson, the Convention's secretary, C.E.A. Offices, Winsley Street, London, W.1.

Schoolboy's Own Exhibition

Visitors are introduced to electronics and automation on the British Electrical Development Association's stand at the Schoolboy's Own Exhibition at the Horticultural Halls, Westminster, which closes to-morrow (Saturday). The main portion of the stand is laid out as a factory, and boys and girls are invited to work a shift in the "Electomic Plant." A specially invented product, the "Tomic," is used to demonstrate the difference between manual assembly on a flow line, and automation. It consists of ten snooker size balls in a vertical transparent tube arranged in the "tomic sequence." Teams of five volunteers man each section to compete against each other in a race to produce ten "tomics" per shift. All boys on leaving the stand are presented with a copy of a magazine containing explanatory diagrams of the plant, and articles dealing with the part played by electricity in industry and with opportunities for careers in the electricity supply industry.

The Metropolitan - Vickers Electrical Co., Ltd., has a stand on which the wide range of its products is illustrated by scale models and photographs. The company has also arranged a "quiz" competition relating either to the exhibits or to matters generally within the scope of a scientifically inclined schoolboy, the prize being a visit to the Metro-Vick Works at Manchester, all expenses being paid. Information is available of the company's scholarship arrangements for university courses and "sandwich" courses.

The English Electric group's exhibits range from tools, made by apprentices, to models of electric and diesel-electric locomotives, aeroplanes, guided missiles, diesel engines, steam turbo-generators and a television studio. Advice is also given on the education and training facilities available at the different English Electric establishments.

Central African Electrical Imports

The predominant position of the United Kingdom in the electrical trade of the Central African Federation (the Rhodesias and Nyasaland) has been maintained during the last year, though competition from the Continent of Europe is steadily increasing, particularly from Western Germany and Holland.

Imports (£000)

Class	1954	1955
Motors and parts	315	441
From United Kingdom ...	218	362
,, South Africa	86	64
,, Switzerland	4	7
,, United States	4	2
Transformers	510	596
From United Kingdom ...	462	517
,, South Africa	47	54
,, United States ...	2	3
,, Sweden	—	15
Switchgear	727	1,032
From United Kingdom ...	664	900
,, South Africa	48	123
,, Switzerland	7	—
,, United States	6	7
Other electrical machinery ...	1,686	1,920
From United Kingdom ...	1,485	1,658
,, South Africa	146	129
,, Italy	—	5
,, Switzerland	8	49
,, United States	35	72
Cables and wires	1,146	1,708
From United Kingdom ...	452	842
,, Canada	3	22
,, South Africa	664	784
,, W. Germany	—	28
,, Holland	13	13
,, United States	15	19
Batteries	359	404
From United Kingdom ...	163	168
,, South Africa	182	215
,, W. Germany	11	9
,, United States	2	5
Conduit tubing and fittings ...	86	156
From United Kingdom ...	61	54
,, South Africa	25	101

Utrecht Welding Exhibition

The Netherlands Welding Society is organising a welding exhibition at Utrecht from 5th to 12th October next. A two-day welding symposium, "The Metallurgy of the Welding of Steel," will be held during the exhibition.

Devon Catering Exhibition

An exhibition of catering equipment, organised by the Devon Sub-Area of the South Western Electricity Board with the co-operation of leading manufacturers, was held in December at the Victoria Hotel, Torquay. Invitations were sent to all hoteliers and to most caterers in Devon, and to a number in Somerset and Cornwall. Representatives from 380 hotels and catering establishments attended; transport by coach was organised by the Board in collaboration with local Hotel Associations. The equipment shown

was mainly suitable for medium or small hotels and catering establishments. Interest in the use of electricity for catering purposes was greatly increased by the Board's recently introduced special tariffs for hotels and for catering purposes.

Trotter-Paterson Memorial Lecture

The fourth Trotter-Paterson Memorial Lecture of the Illuminating Engineering Society will be given on 11th February (6 p.m.) at the Royal Institution by Sir Lawrence Bragg, F.R.S., who will speak on "Some Experiments on the Interference of Waves." Tickets can be obtained from the I.E.S. Secretary, 32, Victoria Street, London, S.W.1.

Integration of Management Institutes

A working plan for the complete integration of the two Institutes is outlined in a letter circulated this month to members of the British Institute of Management and the Institute of Industrial Administration. The letter states that proposals put forward by a joint formation committee have already been approved at meetings of the two Councils held in December. The necessary legal documents are being prepared and extraordinary general meetings of the two Institutes will shortly be called with the object of bringing complete integration formally into effect on 1st April next. It is proposed that the name of the integrated body shall be the British Institute of Management. The name of the Institute of Industrial Administration will remain registered to prevent its use by any other body.

Anglo-Polish Trade Arrangements

Negotiations between representatives of the Government of Poland and the Government of the United Kingdom resulted in the signing of an arrangement in Warsaw on 31st December, providing a basis for trade until the end of 1959. Import quotas will be negotiated annually. The arrangement provides for Polish purchases in this year of some £15¾ million worth of United Kingdom goods, including machinery, radio and television equipment, and substantial amounts of mining equipment and of semi-manufactured goods.

Token Imports

The Board of Trade announces that the Token Import Scheme will continue in 1957 for imports from Canada and the United States on the same basis as in 1956.

"Electricity from Atoms" Exhibition

Organised by the South of Scotland Electricity Board, an "Electricity from Atoms" Exhibition is being held this week at the McLellan Galleries, Glasgow, and closes to-morrow (Saturday). Admission is free. It focuses the attention of the ordinary public on the use of nuclear power for electricity generation and for other peaceful purposes and a special section is devoted to the Board's plan for building in Ayrshire the world's largest atomic power station. Another section deals with the work of the United Kingdom Atomic Energy Authority. There is a small cinema where films connected with nuclear power are shown continuously.

Part of the Exhibition is being used to show the latest domestic appliances.

As a reminder of the progress achieved by the electricity supply industry during the past three-quarters of a century, the generator which provided electricity for arc lamps at Glasgow Post Office for many years before the coming of a public electricity supply is shown. This machine was constructed by Col. Crompton in 1880 and on the opening morning of the exhibition it was officially presented to the sales director of Crompton Parkinson, Ltd., Mr. J. B. Scott, D.F.C., for the company's collection of historic electrical equipment. The chairman of the South of Scotland Electricity Board, Mr. J. S. Pickles, opened the exhibition and made the presentation.

Wolverhampton Handbook

The Wolverhampton Corporation has issued a new edition of its "Official Handbook," giving details of all services and activities of the Corporation and of the many industrial enterprises in the borough. Its 212 pages are profusely illustrated with a number of the illustrations in colour. A chapter is devoted to the electricity supply services provided by the Midlands Electricity Board. The Corporation has also issued two smaller publications. One indicates the welfare services in the borough and the other gives particulars of its cultural and social activities, and sport, recreation and places of entertainment. A list of hotels is also included.

Transistor Audio Amplifiers

A lecture on the use of transistors in audio frequency amplifiers was recently delivered at the Magnet House offices of the General Electric Co., Ltd., in London, by Messrs. K. W. Gurnett, R. A. Hilbourne, D. D. Jones and S. Welldon of the G.E.C. Research Laboratories. The lecture assumed an elementary knowledge of transistors and transistor circuits and was essentially an explanation of a comprehensive 224-page book on the subject which has just been published by the company.

The book is in six sections and begins by explaining the nature and characteristics of transistors and their equivalent circuits. A section on small signal audio frequency amplifiers precedes a chapter dealing in detail with the design of power amplifiers. The main section of the book comprises full descriptions of a number of practical transistor amplifier circuits with outputs ranging from 250 mW up to 20 W. Finally, there is a chapter on special techniques which have to be employed in connection with transistor amplifier design.

The lecture was accompanied by a number of demonstrations of various transistor amplifiers working either in conjunction with microphones, gramophone pick-ups, or radio feeder units.

Electric Irons for the Blind

Morphy-Richards, Ltd., has adapted its "Atlantic" iron for the use of blind people. It has a braille-marked fabric selector dial which has been developed in co-operation with the technical officer of the Royal National Institute for the Blind. The company is supplying 100 of these irons to the Institute and the first of these was recently presented to the Institute by Margaret Rutherford, the actress. The company informs us that it has just produced its ten millionth electric iron.

E.C.G.D. West London Office

The Export Credits Guarantee Department announces that its West London office has moved to Romney House, Marsham Street, London, S.W.1 (telephone: Abbey 6271). This office covers the London postal districts of N.W., W. and S.W., and the counties of Middlesex, Surrey, Sussex, Hampshire, Berkshire, Buckingham and Oxford.

International Electrotechnical Vocabulary

In our issue of 14th December we noted the publication of Group 16 of the second edition of the International Electrotechnical Vocabulary. The British Standards Institution, 2, Park Street, London, W.1, tells us that it can supply copies of this, price 13s 6d.

Trade Announcements

Mr. R. Kingston, "Atlas" area representative in Essex for **Thorn Electrical Industries, Ltd.**, has been transferred to the head office staff of the "Atlas" lighting division with responsibility for developing the sales of projector and photographic lamps throughout the country. His former Essex territory will now be covered by Mr. J. Ludlow.

The London office of **Harris & Sheldon (Electrical), Ltd.**, is now at 46, Great Marlborough Street, W.2 (telephone: Gerrard 8955).

Belling & Lee, Ltd., have appointed Mr. D. W. Rippin, outside technical representative, as export manager. Mr. J. E. Bailey, B.Sc., and Mr. R. E. Meldrum have joined the staff as technical representatives to manufacturers and Mr. A. Fender is appointed technical sales representative to the trade covering Northumberland, Durham, Cumberland and Westmorland, based on Newcastle-on-Tyne.

Clean Air Act

Guidance for Local Authorities

LAST week we reported that certain provisions of the Clean Air Act, 1956, had been put into operation. In this connection the Ministry of Housing and Local Government has circulated two memoranda to local authorities. One of these, " Memorandum on Smoke Control Areas " (H.M. Stationery Office, 1s 3d), gives guidance on the establishment and administration of smoke control areas. Among other things it is pointed out that in any proceedings in respect of the emission of smoke in a control area it will be a defence to prove that the smoke was not caused by the use of any fuel other than an " authorised " fuel, i.e. coke, anthracite, low volatile steam coals, " Coalite," " Phurnacite," " Rexco," gas or electricity.

As we stated in our last issue local authorities are empowered to make grants towards the cost of adapting heating (including water heating) and cooking arrangements in private dwellings built before 5th July, 1956. The installation of " smokeless " appliances in all new dwellings in a smoke control area built after that date can be made obligatory.

Grants for Adaptation Work

Section 12 (1) of the Act makes special provision for the payment of grant in respect of fixed yet readily removable appliances, such as gas and electric cookers, provided by tenants. In the case of such appliances bought under a hire-purchase agreement it is provided that the grant should be based on the cash price of the appliance at the date of the agreement.

Among the works of adaptation eligible for grant is the replacing of a fireplace by another fireplace or by some other means of cooking or heating (including water heating). The Memorandum lays down a set of principles for determining what types and standard of works are reasonably necessary. No additional facilities need be provided. Appliances seldom used (e.g. bedroom fires not in regular use) need not be adapted or replaced. Where " non-offending " appliances form a duplicate means of heating and cooking an " offending " appliance need not be replaced; for instance, if a dwelling has a range cooker (with boiler) and also a gas or electric cooker it is not necessary to replace the range although it may be necessary to provide water or space heating. Where replacement of an appliance is necessary reasonable freedom of choice should be given to the owner or occupier as between solid fuel, gas, electric and oil-burning appliances, provided the total cost of the alternatives (including the cost of installation and incidental works) is broadly comparable. For example, where a dwelling is provided solely with a coal-fired range for cooking and water heating the range may be replaced by (*a*) a free-standing cooker (with boiler), (*b*) an approved combination grate (with boiler), or (*c*) an open fire with back boiler plus a gas or electric cooker.

Portable gas, electric and oil fires cannot rank for grant since no works of adaptation are required. Where necessary, however, gas or electric points may be installed to serve instead of existing fireplaces. Necessary incidental work may include the provision of gas ignition to open fireplaces and extensions of gas piping or electric cable.

New appliances, to qualify for Exchequer assistance, should be selected from approved lists, including the list of " Recommended Domestic Electrical Appliances " compiled by the British Electrical Development Association. More detailed advice regarding selection, installation and operation of appliances is obtainable from the Electricity Boards.

It is noted that where a landlord undertakes works of adaptation in a dwelling house, the works may qualify as an improvement in respect of which a controlled rent may be increased.

In a section dealing with the establishment of smoke control areas the Memorandum states that one point to be borne in mind when the subject is being considered is the assurance that supplies of smokeless fuels will be available. To assist in this respect the Minister of Fuel and Power is setting up regional advisory committees on which the fuel interests, including the Electricity Boards, will be represented.

Local authorities should also bear in mind the demands which alterations in heating and cooking arrangements may make on local builders and on the Gas and Electricity Boards, should distribution facilities have to be extended.

The enlistment of the aid of local newspapers and the various fuel authorities is counselled when it is proposed to establish a smoke control area.

Among the appendices to the Memorandum are proposed schedules of estimated and final costs of adapting and replacing fireplaces which include columns for gas or electric fires, immersion heaters, gas or electric cookers and wash boilers.

The second Memorandum referred to relates to miscellaneous provisions (H.M. Stationery Office, 8d). Among the matters with which it deals are installation of new furnaces (which " so far as practicable " must be smokeless) in industrial and commercial establishments; the provision, use and maintenance of smoke density meters, etc.; and the height of chimneys.

Provision of Energy in Europe

THE Organisation for European Economic Co-operation has established an Energy Advisory Commission of five experts to review periodically, and report to the Council each year with comments, the forecasts and statistics of member countries' energy requirements. It will consider reports from the O.E.E.C. technical committees on coal, oil, electricity, gas and nuclear energy in relation to national investments and assess before 1959 the prospective requirements for 1960, 1965 and 1970 and the gap between these and the production envisaged. The Commission will collaborate with a new Energy Committee on which Governments will be represented by senior officials who will submit proposals to the Council for co-ordination of national resources in order to ensure agreed action by Governments, especially in regard to adequacy of investment in energy production.

Consumption of electrical energy in 1955, as stated by the Economic Commission for Europe, reached 625,000 million kWh. This was 10·6 per cent more than in 1954, compared with 12 per cent for the whole world, 13 per cent for the U.S.S.R. and 15 per cent for the U.S.A. A few new transmission lines across frontiers were put into service. Supplies of this kind were being studied by *ad hoc* bodies, such as " Interalpen " for Austria and " Yougelexport " for Yugoslavia. The harnessing of certain parts of the Danube, Lake Presper, and some rivers in the north of Greece were also under discussion. It was recommended that hydro-electric resources should be assessed on gross mean annual run-off potential.

By
J. B. CARROLL,
M.Sc., A.I.M.*

Electric Heat Treatment Furnaces

Survey of Current Designs and Applications

THE basic form of any furnace is like that of the ordinary horizontal batch type, which consists of a rectangular metal casing lined with graded refractory and insulating bricks, with a door giving access to the heating chamber so formed. Such a furnace can be heated by any combustible fuel or by electricity. During the last 20 or 30 years, manufacturers have produced numerous types of furnaces to meet the increasingly critical and exacting demands of users. In addition to keeping pace with modifications and refinements to existing well-tried processes, they have also originated completely new methods of heat treatment and developed specialised equipments in which they can be applied.

Heating Elements

One of the essential features of any furnace is the means of heating and when electrical resistance heating is to be employed, the designer must select, carefully, the material of which the element is to be constructed and the form in which it is to be used. The electrical resistance of the material chosen must remain reasonably constant no matter what the temperature may be, and it must be chemically resistant to the atmosphere obtaining in the furnace. It must also be relatively inexpensive. The materials which most nearly fulfil these conditions are alloys of nickel and chromium, or nickel, chromium and iron. These materials have been found to give a reasonably satisfactory performance and their behaviour under known furnace conditions can be quite accurately predicted.

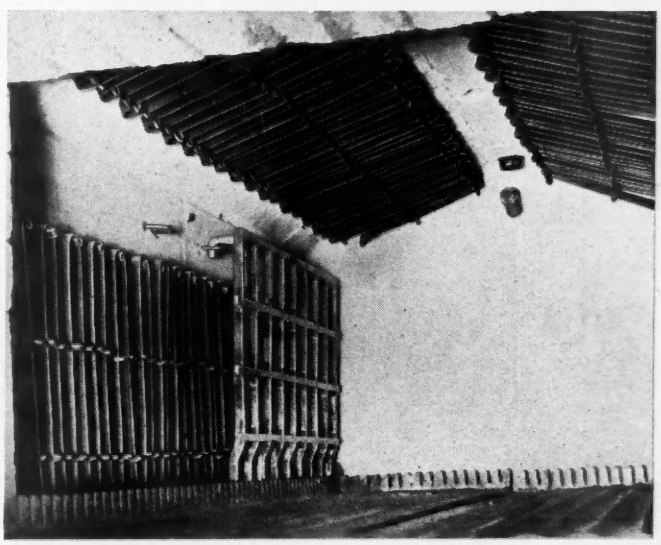
With regard to the form of the element there are many factors to be considered, the most important being useful life. So far as this is concerned, an element which is shielded by refractory will run hotter and will have a shorter life than one which is freely radiating. Again, a straight nickel-chromium alloy element may be perfectly scale resistant when operating in air up to quite high temperatures but if an artificial atmosphere is employed and this becomes contaminated with, for example, sulphur compounds or hydrocarbons, the element may suffer severe attack. To overcome these and other difficulties the furnace designer selects materials and determines element design in the light of experience as well as from scientific considerations.

Turning to the distribution of temperature in the furnace, it is frequently necessary to grade the elements in relation to the heat demand in various parts of the furnace, to provide separately controlled elements at various points to compensate for excessive heat losses and to sub-divide the furnace into two or more separately controlled zones where circumstances demand it. In general, metallic elements are fitted in one of the following forms : helical coils of wire mounted on ledges built in the brickwork ; sinuous tape elements which are pinned to the brickwork by either metal or refractory pegs or alternatively mounted into slotted bricks; or heavy section rods either in straight lengths or bent to a more convenient shape. For certain applications where conditions are particularly severe, heavy cast grids of nickel-chromium alloy are used, the whole grid hooking into metal supports built in the furnace walls.

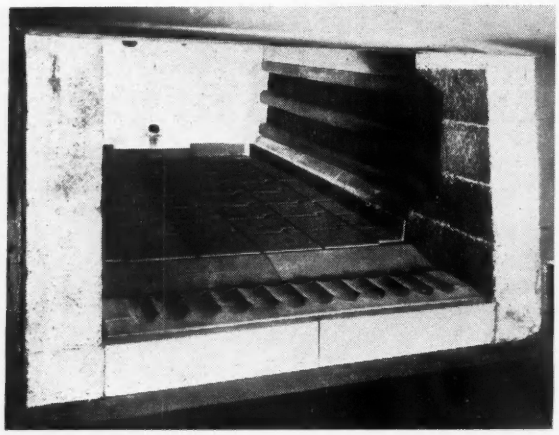
Atmospheres which are commonly encountered in modern heat treatment processes are often strongly carburising to element material. These atmospheres may be deliberately intended to carburise the charge being treated, or they may be accidental, arising from the gases produced by the decomposition of cutting or drawing lubricants, rust preventatives, etc., carried into the furnace on the surface of the charge. When an oily charge is loaded, the oil first vaporises and subsequently cracks and, under certain conditions, forms soot and/or hydrocarbon gases. If such an atmosphere is in contact with a heated element, carbon is dissolved in the alloy and combines with the chromium, already in solution, to form an insoluble carbide. Particles of chromium carbide are eventually precipitated along grain boundaries and cleavage planes, and the area in the immediate neighbourhood becomes depleted of chromium and is no longer oxidation resistant. It will be appreciated that the mechanism of the reactions is over-simplified here, but the danger to the element is obvious. This type of attack is sometimes serious enough to render a new element completely unserviceable after only a few days' operation.

The only really satisfactory way to eliminate this type of failure is prevention of the conditions in which it takes place, although alloys which are more resistant to attack are being developed. Where the gases produced are accidental the charge should be cleaned prior to loading

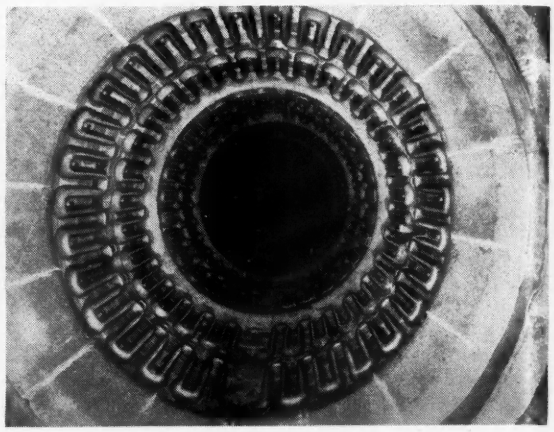
Method of pinning sinuous tape elements in horizontal and vertical positions. The removable grid, at the left-hand side, is to prevent accidental contact between work pieces or tools and the elements



* Chief Metallurgist, Birlec, Ltd.



An alternative method of holding tape elements in slotted refractory bricks. In this illustration a javelle type of flexible hearth is employed



View looking into furnace used for hardening gun barrels showing cast grid elements and method of support

into the furnace. When the atmosphere is intentionally carburising, the elements are isolated from it either by treating the charge in a muffle which contains the gas, or by making the elements in the form of radiant tubes. For reasons of cost the former are generally only applicable when small sized muffles are required, the radiant tubes being used on larger installations.

Radiant tubes consist of suitable resistance wire wound on to refractory formers which are placed inside a gas-tight heat resistant alloy tube. The design is not simple since the element is only radiating from approximately one-half of its periphery into an enclosed space. If the rate of heat dissipation from the outer surface of the enclosing tube is insufficient the element becomes overheated and, in extreme circumstances, melts. Rapid heating of the element wire causes high-temperature gradients in the refractory former and the latter must, therefore, be resistant to thermal shock. It is usual to design furnace resistors to operate at a low voltage and high amperage and it is good practice to use the heaviest element section with the lowest surface dissipation rate that is economically possible.

So far, only metallic elements operating up to about 1,100 deg C have been considered. Until recently, whenever higher temperatures were required, non-metallic elements, e.g. silicon carbide, were used for practical heat treatment. Now, however, a nickel-chromium-aluminium alloy has been developed which is suitable for continuous operation up to 1,200/1,250 deg C, while Kanthal, a Swedish element material, is stated to be suitable for use up to 1,350 deg C.

It is still, however, more usual to employ silicon carbide elements which are suitable for temperatures up to 1,400 deg C. There are certain disadvantages associated with the use of this type of material, chief of which are a short operating life, about 10,000 hours, susceptibility to mechanical and thermal shock, and a tendency to age. This last point is of extreme importance because with use, the resistance of the silicon carbide element increases and to compensate for this a higher voltage must be applied. When this type of element is used, therefore, a multi-tap transformer is provided to allow for adequate compensation. In this connection, a system has recently been evolved by means of which the impedance of the circuit is adjusted to give automatic compensation as the resistance varies, but this is in the experimental stage.

Batch Furnaces

The modern batch furnace bears little resemblance to its earlier counterpart. Consider, for example, an ordinary tool room hardening furnace consisting of gas-tight outer casing lined with suitable refractory material. Elements are situated on the side walls and roof as well as under the metal hearth plate. The door, either manually or mechanically operated, has on the inner refractory face a small element dissipating about 10 per cent of the total rating to reduce heat losses to the minimum. An alternative arrangement to this is to burn a gas-air mixture across the door opening. This not only provides heat but also an atmosphere, from the combustion products, which helps to protect the charge during treatment. The furnace is equipped with automatic temperature control and the whole hearth area has a uniform temperature distribution of ± 5 deg C. With proper maintenance and careful use elements and hearth plates have a life of two to three years. The gas-tight outer casing permits the use of an artificial atmosphere which may be required to prevent scaling or decarburisation of the charge.

Bright Hardening

The carbonitriding or bright hardening furnace is now being accepted by users in industry in ever-increasing numbers, and although generally heated by means of gas fired radiant tubes, several furnaces of this type employing electric radiant tube elements have been made.

The furnace consists of a heating chamber situated behind a charging vestibule, the former being fitted with a powerful circulating fan. Both heating chamber and charge vestibule are gas tight and may be filled with an atmosphere of the endothermic type. Access from outside to the heating chamber is through the vestibule via two in-line but independently controlled doors. Inside the vestibule is a double-tiered elevator, so arranged that in the raised position the lower elevator table is level with charge support rollers inside the heating chamber, and when lowered the upper table is level with these rollers. In the lowered position the lower table passes into an oil quench tank which is integral with the vestibule.

A charge, which usually consists of small components such as bolts, typewriter parts, etc., is loaded into a rectangular basket which may be inserted through the vestibule into the heating chamber. The door to the heating chamber is closed, and the furnace is purged by means of endothermic gas fed into the heating chamber from an external generator. Purging is complete when a strongly combustible gas is percolating from the furnace chamber to the vestibule via the inner door. At this stage, after ensuring that the elevator is in the raised position, the outer,

or vestibule, door is closed. The burning gas from the furnace chamber consumes all the oxygen inside the vestibule and eventually a combustible gas issues from the atmosphere exhaust vents in the outer door and purging of the whole unit is completed. The charge is subjected to the desired treatment (normally carbonitriding although the furnace is used for carburising and for hardening) and is ready to be quenched. The inner or furnace door is opened and the charge basket is transferred from the furnace to the lower table of the elevator, which it will be remembered is already in the raised position. The elevator is lowered, so that the charge is quenched, and at the same time the inner door is closed. After about 2-5 min (i.e. just sufficient time to allow the quench oil to become cool enough to eliminate any risk of firing), both outer and inner doors are opened and another charge is placed in the heating chamber. After reloading, the inner door is closed, purging of the furnace proceeds as before and the already quenched charge is raised and unloaded. This leaves the elevator in the upper position and the process is repeated.

A short description of the carbonitriding process may not be inappropriate at this stage. The process is also called dry or gas cyaniding, ni-carbing and nitro-carburising, but "carbonitriding" appears to be the term now being accepted in industry. The process is possible because steel is able to absorb carbon and nitrogen simultaneously in the temperature range of 750 deg C to 900 deg C (practical upper limit). In the practical process described, the endothermic atmosphere maintains the steel surface chemically clean and therefore active, whilst the cracking of (*a*) added hydrocarbon such as propane and (*b*) anhydrous ammonia provides the necessary carbon and nitrogen. Although a wide temperature range has been quoted, that generally preferred is 820/870 deg C in which the optimum balance between carbon and nitrogen in the surface can be maintained.

Carbonitriding has a number of advantages over other case hardening processes. For instance, carbonitrided surfaces are held to be more wear resistant than carburised surfaces. By carbonitriding, oil quenching may be employed to harden steels which otherwise have to be water quenched. This is because nitrogen in solution increases the "hardenability" of steel. Oil quenching coupled with the lower temperature of treatment, 850 deg C instead of 930 deg C for gas carburising, results in less distortion and reduces quenching cracks to negligible proportions.

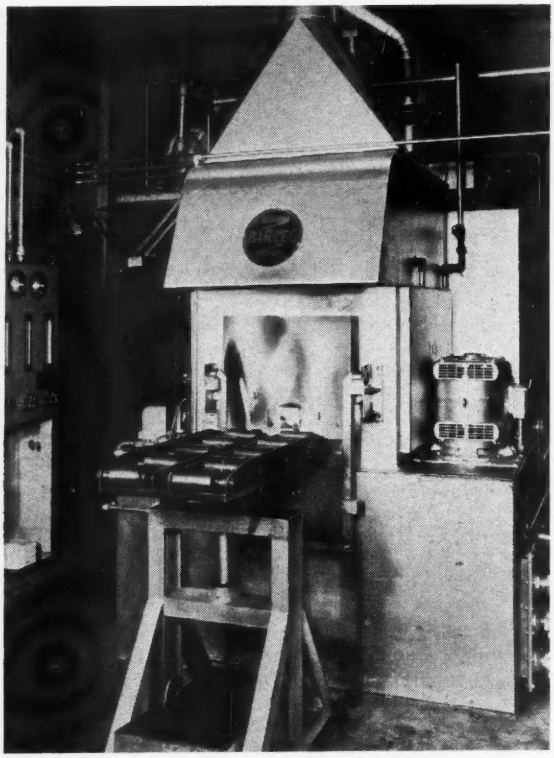
Lower quality steels may sometimes be employed when carbonitriding is the final heat treatment because of the increased hardenability. Treatment times are no longer than those for gas carburising despite the lower temperature, and no dangerous effluent or waste has to be removed as is the case with cyanide processes. The process is inexpensive, the running cost being about a third to a half of that for cyaniding.

There are disadvantages, however, as the process is only economically suitable for producing light cases up to about 0·025 to 0·030in in depth and sufficiently large production quantities of small components to keep the furnace occupied are necessary if the full economic advantages which the process offers are to be realised. Although the surface of material normally water quenched may be adequately hardened with an oil quench, the core hardness may be insufficient. Excessive solution of nitrogen may result in retention of austenite at the surface.

Malleabilising Iron Castings

A third example of a horizontal batch type furnace is the elevator furnace, which is used mainly for malleabilising iron castings. In the past, the castings were packed into drums containing iron ore, lids were luted on and the drums pushed into a kiln and left to heat, soak and cool for a week or more. The modern development consists of a hearth, on tracks, which is loaded with the white iron castings (a single charge of 6-8 tons being commonplace), rolled under a raised furnace body where projections engage into lifting hooks. The hearth is lifted up into the furnace which is made gas-tight by means of a seal skirt engaging in a sand trough which is on the periphery of the hearth. Power is supplied to the elements and the treatment cycle

Typical large gas carburising installation using a pit type furnace. To the left a gas carburising furnace and cooling pots; to the right two tempering furnaces in the foreground with a roller hearth hardening furnace in the background



Batch furnace for bright hardening, carburising or carbonitriding. The charge table and integral quench tank are in the foreground; part of the control panel is visible on the left

of heating to 1,000 to 1,050 deg C is commenced with subsequent very slow cooling at a controlled rate throughout the lower critical temperatures. Since for whiteheart malleable annealing, at least, the process is one of decarburisation, a "self-regulating" atmosphere is employed. Initially, the furnace is cold and full of air. As the temperature rises after loading, the oxygen present combines with the carbon in the iron to form a CO/CO_2 mixture. This effluent is taken from the furnace and used to heat a water boiler and produce steam which is led back to the furnace where the well-known water gas reaction takes place,

$$C+H_2O=CO+H_2.$$

As the amount of carbon in the castings decreases due to decarburisation so do the amounts of carbon monoxide and hydrogen in the effluent gases used for heating the water boiler. Hence, the heating capacity of the gas falls and the quantity of the steam produced decreases.

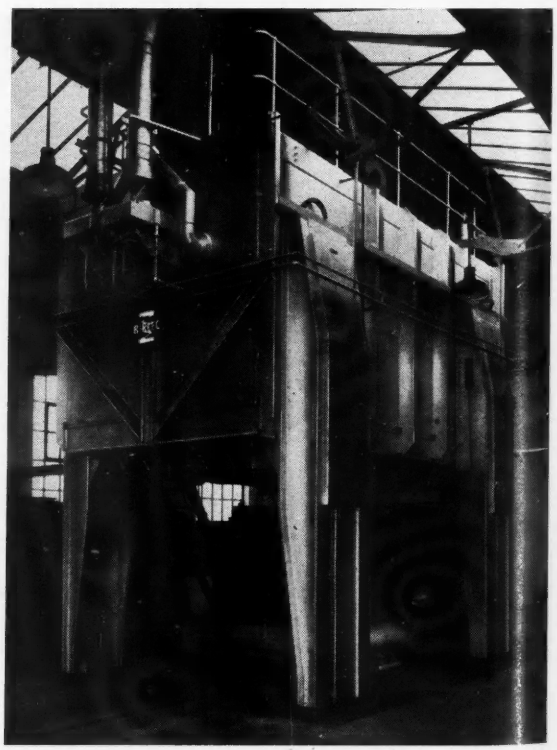
This method of malleabilising involves costly equipment operating at high temperatures and so maintenance costs are relatively high. Nevertheless, the net load is so great and the time saving so much—anneals that took a week or more now taking only 48 hours—that the cost of malleabilising has been drastically reduced. In addition, because of the degree of control required in the foundry when material for short cycle annealing is being made, a very considerable improvement in the quality of the castings produced frequently results.

Among the many kinds of vertical furnace the pit gas carburising furnace is probably the most familiar. This furnace was quite a rarity before the commencement of the last war, but the necessity of high rates of good quality production, utilising as small a floor space as possible, resulted in its general acceptance. Like the gas malleabilising process, gas carburising has replaced the old-fashioned pack method in most applications. The furnace consists of a cylindrical casing lined with the usual refractories supporting the heating elements. A removable cylindrical retort acts as the charge chamber; this is made gas tight at the bottom end either by fitting into a sealing trough containing sand or oil, or by having a solid bottom. At the top a domed lid fits into a sand seal carried on the retort. Inside, a powerful circulating fan maintains the applied atmosphere in constant circulation. The charge baskets rest on a stool inside the furnace, and having solid sides, act as a baffle to direct the circulating gases through the charge. The atmosphere used is generally an endothermic type carrier gas enriched with a hydrocarbon such as propane. Coal gas is sometimes used after it has been treated to remove unwanted constituents such as carbon dioxide and water vapour, which are decarburising, and unsaturated hydrocarbons which tend to deposit soot on the charge. An alternative type of atmosphere developed in recent years is derived from the pyrolysis of certain organic liquids, mainly alcohol/benzene mixtures, which are dripped into the furnace chamber at a controlled rate.

Another pit furnace which is receiving considerable attention from the aircraft industry amongst others, is the pit type brazing furnace used in conjunction with a pure dry hydrogen atmosphere for bright annealing and fluxless brazing of stainless steel and nimonic type alloys.

Continuous Furnaces

As with other manufacturing processes, in recent years there has been a marked increase in the demand for mechanisation. The conveyor systems of continuous furnaces are of a truly remarkable variety and almost any type of component can be efficiently handled by one or



Furnace used for annealing malleable iron castings showing the loaded hearth in the lowered position

another of them. There are woven mesh belt and cast link belt conveyors for fabricated products and forgings in bulk; the driven roller hearth for strip, rod and tube; and the walking beam for billets, bars and sheets. Rotary hearth and rotary drum furnaces, pusher tray furnaces and shaker hearth furnaces are also available. The shaker hearth furnace has a reciprocating hearth plate along which the work is moved by virtue of momentum imparted to it by the reciprocating action. It is designed primarily for the continuous hardening of very small objects such as pins, needles, watch components, etc.

Mesh belt conveyor furnaces find their greatest application in copper brazing and bright normalising steel parts. The identical furnace can be used for either application by merely selecting the correct operating temperature, but output is smaller when the equipment is used for copper brazing because the operating temperature of 1,150 deg C, compared with 950 deg C for bright annealing, reduces the mechanical strength of the belt and hence the weight which it can carry.

The development of high-strength heat resistant alloys has made possible the operation of conveyor mechanisms at temperatures previously considered excessively high, and processes once difficult to adapt to conveyor furnaces may now be reconsidered in the light of present knowledge and experience. Difficulty was frequently encountered with the fine control of conveyor systems on long cycle work such as gas carburising, but the pusher tray furnace is now being used for this process which demands intermittent operation, linked with simultaneous automatic charge and discharge via atmosphere lock chambers.

Annealing of cartridge cases is a process which is readily adapted to complete mechanisation. Cold-drawn brass cases are hopper fed into a rotary drum furnace which contains a large archimedean screw along which the cases travel. They are passed into a quench tank (either spray or dip) and thence into pickling drums. Still on a conveyor they pass through washing tanks and are finally dried by hot air.

Future Trends

The last 20 to 30 years have witnessed the widespread adoption of the electric furnace by the metal industry for the purpose of heat treatment. Reasons for its popularity include quiet and clean operation, precise control of heating

Mesh belt conveyor furnace used for bright normalising, copper brazing and non-ferrous annealing and brazing

time and temperature and ready application to operation with artificial atmospheres. At that time, gas-fired furnaces possessed none of these advantages, but now, improved burners, proportionating control and radiant tube burners have brought back the gas-fired furnace to a position where it can now compete with the electric furnace. In fact, for certain types of large furnaces now being installed it is more economical to install gas-fired units than electrically heated ones.

However, this is not a static position. Rising costs of both gas and electricity are making users consider more and more the possibilities of firing by means of propane. This, as a by-product of petrol refining, is plentiful and purchased in bulk tank car lots is cheaper than town's gas. Unless some radical change in supply conditions takes place it seems likely, therefore, that both town's gas and electricity will be displaced as heating media, at least in larger installations.

Conductivity Tests

AT a recent meeting of the Non-Destructive Testing Group of the Institute of Physics, Dr. R. W. Powell (National Physical Laboratory) delivered a lecture in which he described some conductivity test methods and results. The main theme of the lecture sought to establish the claims of thermal conductivity for recognition as a property of value for non-destructive tests, but references were also made to electrical conductivity methods.

The methods normally employed for the measurement of both conductivities were described and there was a résumé of the inter-relation of these two properties and their dependence on temperature, purity and physical state.

Demonstrations were given showing the classical methods of de Sénarmont and Ing. Hausz, but both were modified by the substitution of cooling by solid CO_2 for heating and the consequent frost deposition for wax melting. These were methods in which thermal conductivity provided a non-destructive test, with no change in the test material.

The closing section of the lecture referred to measurements carried out at the N.P.L. within the past two months, which were reported for the first time. These measurements had as their basis the well-known experience that by merely handling objects in thermal equilibrium it was possible to grade them according to their thermal conductivities. Such a procedure might be regarded as the simplest of non-destructive tests. The aim of the present work was to replace the physical sensation by a readily measurable quantity. The method chosen was observation of the initial rate of change of temperature of a small, partially insulated metal sphere when brought into contact with a test material at a different temperature. Results were shown indicating that these measurements, which only occupied a few seconds, could be used for the determination of thermal conductivity values over the full range for solid materials. The device formed the subject of British Patent Application No. 33588/56 dated 29th November, 1956.

Heat Pump Operation

I.E.E. UTILISATION SECTION PAPER

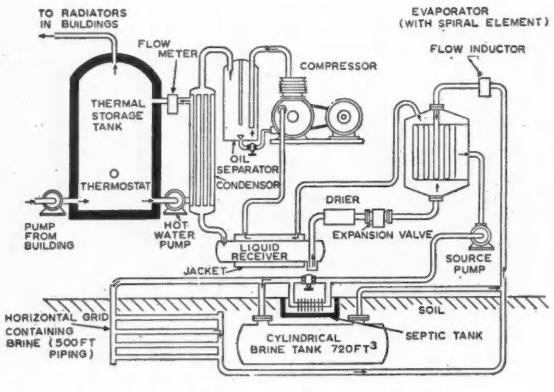
AN integrating paper on aspects of heat pump operation in Great Britain was presented on 10th January by Miss M. V. Griffith (Electrical Research Association) before the Utilisation Section of the Institution of Electrical Engineers. The practical criterion of performance of a heat pump was described as the performance-energy ratio, which was at best 50 per cent of the ideal, $T_1 (T_1 - T_2)$, but p.e.r. values of 3 and upwards were readily obtainable.

The output of pumps using natural resources was at present limited to between 120 and 160 deg F, and Table 1 illustrated the most probable conditions of application. The p.e.r. values in the sixth column took into account plant efficiencies and comparison with those in the seventh column indicated the scope for improvement.

The greatest potential market was for domestic application (including fractional h.p. units) in which the incorporation of electric motor losses in the heat cycles was worth consideration. The development of higher efficiency compressors and larger hermetic units would also be of value. Combination of water heating and seasonal base-load space heating with thermal storage would improve the otherwise poor load factor. Dual-purpose units for cooling as well as heating, either concurrently or alternatively, were also possibilities but appeared to have restricted uses in Britain.

Three heat pumps had been in operation for several years at two Midland electricity generating stations. Laboratory tests on a 5 h.p. heat pump showed that water at 130 deg F, suitable for panel radiators, could be obtained at a p.e.r. of 3, if the source of low-grade heat were between 40 and 50 deg F. At 80 deg F a p.e.r. of 5 could be expected, or higher in large units.

Particulars were given of a 10 h.p. unit (see diagram) installed in 1951 to heat a laboratory building at the E.R.A. Agricultural Establishment at Shinfield, near Reading. The only ample source of low-grade heat available was soil, mainly clay. Since the ground area was insufficient for 2,000ft of $\frac{3}{4}$in diameter pipe required to collect heat from the ground at the rate of 20 kW (68,200 B.Th.U/hr) the main source of low-grade heat was a cylindrical tank of 720 cu ft. The heat-collecting medium was circulated continuously through the tank, grid and coil-evaporator by a 0·75 h.p. pump.



Schematic diagram of heat pump at Shinfield

TABLE I

Use for heat	Heat distribution medium	T_1	Source of low-grade heat	T_2	Values of p.e.r. possible	Values of p.e.r. achieved
		deg F		deg F		
Space heating	Air	90–100	Air	25	5·9	4·0
			Exposed water	38	6·9	5·2
			Ground water	50	8·2	5·5
			Soil	32	6·5	5·0
			Waste heat	70	11·5	6·0
			Waste heat	80	14·1	6·0
Space heating	Water	120	Air	25	5·1	3·2
			Exposed water	38	5·7	4·3
			Ground water	50	6·5	5·0
			Soil	32	5·4	4·0
			Waste heat	70	8·5	6·0
			Waste heat	80	9·7	6·0
Hot water storage* and utilisation	Water	140	Air	25	4·4	3·0
			Exposed water	38	4·9	3·7
			Ground water	50	5·5	4·0
			Soil	32	4·7	3·5
			Waste heat	70	6·7	5·0
			Waste heat	80	7·3	5·5

* The possible use of hot water for soil heating and other horticultural work may be included.

The maximum heat load for the Shinfield heat pump was calculated for an air temperature of 65 deg F inside the building against 30 deg F outside. The daily energy consumption per degree F difference between internal and external air temperatures was 3·6 kWh compared with 10 kW equivalent for a similar adjacent gas-heated laboratory. As against means of heating other than gas, the absence of provision of access for fuel lorries, storage of fuel and boiler attendance at Shinfield would largely offset the extra capital cost of the heat pump.

Such applications of the heat pump in industry as drying or evaporation offered great economies in production costs; e.g. the total cost per ton of evaporating water might be only one-quarter of that by ordinary methods. There was clear justification for the electricity supply industry to develop the heat pump to satisfy a popular demand for a form of heating which did not make use of solid or imported liquid fuel in areas where electricity in conventional forms provided the only alternative. Further trials were needed to provide operational experience.

Dam Construction Data

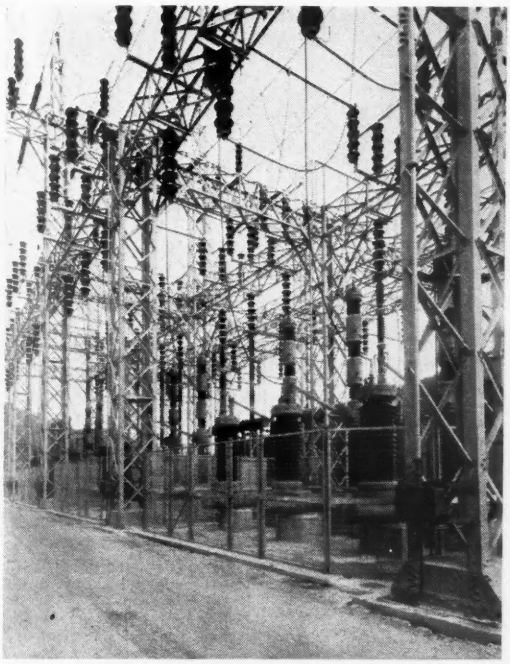
DETAILS of a broad range of cost-saving devices and new methods in the construction of hydro-electric installations will be made available as a result of a meeting of specialists held recently in Geneva. The meeting, sponsored by the United Nations Economic Commission for Europe's Electric Power Committee, examined 43 reports prepared by experts from Spain, Finland, Greece, Italy, Portugal, Federal Republic of Germany, Sweden, Turkey, U.S.S.R., Austria, Roumania, Czechoslovakia and the United States.

Many of the papers were illustrated with slides, charts, diagrams and photos. They dealt with the characteristics of hydro-electric stations constructed in various countries since the last war, on advances and future prospects in the construction of hydro-electric stations through better organisation and mechanisation, and on construction methods saving cement, metal consumption and manpower.

A volume containing the statements, and summaries in the three working languages of the E.C.E.—English, French and Russian—of all the reports which were presented, will be issued shortly. The meeting of specialists proposed that the Secretariat should draw up a bibliographical index of works published in the field of hydro-electric construction and installations with an abstract accompanying each title.

MANUFACTURING PROGRESS IN 1956

English Electric Co., Ltd.



English Electric 165 kV air blast circuit-breakers for Vila Nova power station, Portugal

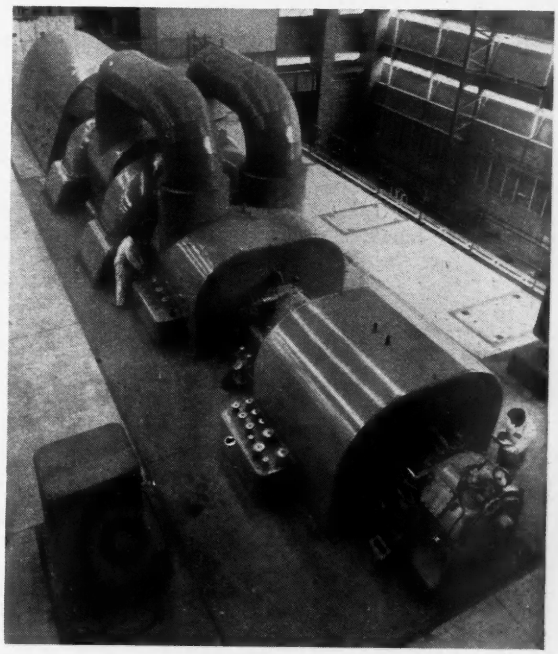
LAST year was a busy period for the English Electric Co., Ltd., in all fields of manufacture. Orders received by the Steam Turbine Division included turbo-alternators for the Central Electricity Authority, the South Durham Steel & Iron Co., Ltd., Northern Ireland, New South Wales, Saskatchewan, Sudan and Malaya. The two 120 MW sets for the Belvedere power station of the Central Electricity Authority are three-cylinder machines coupled in line, running at 3,000 r.p.m., and operating at 1,500 lb/sq in and 1,000 deg F, reheating to 1,000 deg F. The order for the South Durham Steel & Iron Co., Ltd., was for six 6,500 kW back pressure machines operating at 600 lb/sq in and 825 deg F with 190 lb/sq in back pressure. Export orders include two 100 MW sets for the Tallawarra power station of the Electricity Supply Commission of New South Wales, the largest sets yet ordered for Australia. These machines will operate at 1,500 lb/sq in and 1,050 deg F.

There was a considerable increase in business in the Transformer Department and the company received a contract for 330 kV transformers, the first to be placed in this country. Two 162 MVA, 330/132 kV three-phase banks for Sydney, New South Wales, are to be supplied with power from the Snowy Mountains Scheme. This order was followed by another for three 240 MVA, 330 kV three-phase banks of generator transformers for the Kariba Gorge power station in Rhodesia. Export orders exceeded those of previous years and included two 345 MVA, 165 kV generator transformers for the Tennessee Valley Authority, U.S.A., which are the largest three-phase units ever to be built. Other contracts were for four 150 MVA, 264 kV transformer banks for South Africa, three 125 MVA, 220 kV transformers for India, and three 115 MVA, 161 kV units for Canada. Transformer business from the C.E.A. was maintained at its usual high level throughout the year.

The demand for all types of distribution transformers increased during 1956. This applied also to substation transformers for 33 kV service. An increased volume of business was received from overseas markets. A steady level of orders has been maintained for English Electric "C" and "E" cores, transformers and chokes for use in electronic equipment.

Switchgear activity was well maintained during the year and many important contracts were received for high-voltage airbreak switchgear for power stations including the atomic energy power stations at Calder Hall and Chapel Cross. Among others, the following home and overseas stations can be mentioned: Agecroft, Poole, Little Barford, High Veld and Tennyson. Many repeat orders were received from overseas and there was an increase in industrial switchgear business in both the home and export markets.

The Hydro-Electric Department recorded substantial export orders during the year including a sub-contract by the Merritt-Chapman & Scott Corporation, U.S.A., for eight turbo-generator sets and five associated step-up transformers for the Priest Rapids power station of the Grant County Public Utility District No. 2, Ephrata, Washington State. The equipment comprises eight 114,000/131,000 h.p. feathering propeller turbines for 78/84ft head; eight 83/95 MVA, 13·8 kV, 60 c/s umbrella-type alternators operating at 85·7 r.p.m.; and five

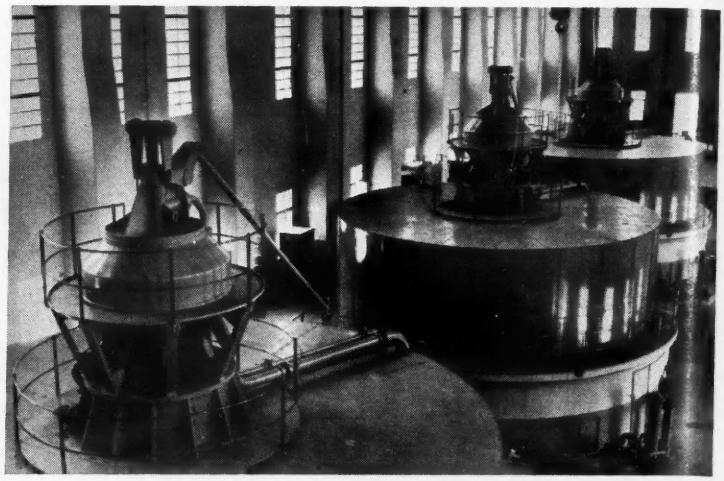


One of eight 60 MW English Electric hydrogen cooled turbo-alternators in Marchwood power station

183 MVA, 13·2/230 kV, three-phase transformers. A repeat order was received from the Aluminum Company of Canada for a second 132 MVA alternator for its Kemano power house.

A comprehensive contract was placed by the New South Wales Government for Warragamba power station, and from the Uttar Pradesh Government (India), whose Khatima station has recently been completed, an order was received for five 77,000 h.p. reaction turbines for the Rihand scheme operating under a head of 143/225ft together with 61,000 kVA, 11 kV, 50 c/s, 150 r.p.m. alternators and auxiliary switchgear.

The Metal Industries Division had a busy year and large orders were received both from home and abroad. Among export contracts were a rod and bar mill for Calcutta; a structural mill drive complete with auxiliaries for Hirapur; an intermediate mill and a billet mill drive, together with auxiliary motors, transformers, switchgear, fusegear, rectifiers, and traction equipment for Durgapur; and steelworks drives for Spain. The Spanish contracts cover equipment for a rod mill for Neuva Montana, Santander, and for a blooming mill at Zumarraga.



Three 13·8 MW umbrella type alternators in Khatima power station, India

Substantial orders received for the home market included main drives and auxiliaries for a Morgan rod and bar mill for Dorman Long; a Brightside copper rod mill for British Insulated Callender's Cables; the addition of a 4,000 h.p. slab edger drive to the English Electric twin drive for the Steel Company of Wales, Margam Works; a complete set of main drive equipment and auxiliaries for a 40in blooming and slabbing mill, and a four-high plate mill, for Patent Shaft & Axletree, Wednesbury, together with many smaller cold mills and process lines.

The increasing application of sealed, air-cooled, steel tank mercury-arc rectifiers for supplying power to rolling mill motors is shown by orders received during 1956. Equipments up to 3,500 kW each have been ordered for a billet mill and for three rod and bar mills, grid control being used in every case for starting and motor speed control. Orders for mill auxiliary rectifiers include one totalling 11,650 kW for a new steelworks to be erected in India. Repeat orders were received from a number of home and overseas steel mills. Steel tank rectifiers are involved in the first two full-scale trolley locomotive schemes for mines in this country. Overseas traction orders included 2,500 kW, 3,000 V equipment for South African Railways, and equipments for mines.

In many contracts for mine winding equipment the company was responsible for both the mechanical and the electrical parts and in the majority of cases acted as main contractor. Some of these orders included equipment for modernising existing installations to comply with present-day regulations. Most of the orders placed by the National Coal Board comprised geared a.c. equipments having orthodox manual control with ground mounted single or double drums. Speed control on some of the winders is by means of metallic resistances and rotor contactors. A typical overseas contract was a twin 4,000 h.p. geared a.c. winder for South Africa. Various orders have been received for dynamic braking equipment to be added to existing winders which are not of English Electric manufacture.

In addition to electric train equipments for the Southern Region of British Railways and 400 h.p. diesel-electric shunting locomotive equipments for the British Transport Commission, the Traction Department received a repeat order for 2,000 h.p. diesel-electric locomotives for the Rhodesia Railways and 3,000 V, 2,000 h.p. electric locomotives for South African Railways.

The work of the Electrical Plant Department ranges from installations of motors for driving power station auxiliaries to complete electrification schemes covering a wide range of applications in factories, dockyards, testing stations, research laboratories, Government establishments and so on. Orders received during the year included large synchronous motors for driving fans, compressors and log grinders; alternators driven by steam turbines and oil engines; and induction motors driving fans, pumps and fuel mills in steam power stations. Contracts for variable speed d.c. applications included the power unit for a ship testing-tank carriage, engine testing dynamometers, aircraft auxiliary test plant and other high-speed test rigs. One of the most noteworthy contracts completed during the year was the trans-sonic wind tunnel drive at Bedford for the Aircraft Research Association, Ltd.

The company's full production of diesel and dual-fuel engines has been maintained over the past year and has continued to find markets both at home and abroad. In the gas turbine field erection of the first 20,000 kW gas turbine for the Royal Aircraft Establishment, Bedford, has been completed and the set is now undergoing tests before commissioning. Erection of a second set is proceeding.

Development is proceeding on new types of drives and electrical equipment for civil and military aircraft. Of particular importance is the design of generating equipment for operation at the high temperatures associated with high-speed aircraft. Development work has also continued on a new d.c. starter generator.

The demand for h.f. induction heaters between the range 2 kW to 60 kW has been maintained. During the year standard magnetic amplifiers for 50 c/s and 400 c/s supplies, and for outputs from 150 to 1,500 W, have been used on a number of auxiliary drives in steel mills. The standard ½ h.p. "Magamp" controlled motor unit has been adapted for machine tool drive on a number of contracts. Electronic voltage regulators have been supplied for a number of schemes, and several installations of electronic turbine supervisory equipment, including some for overseas, have been completed. Ten DEUCE computers have been installed at home and overseas; two of these equipments are repeat orders.

NEW ELECTRICAL EQUIPMENT

Reversing Magnetic Starters

A new range of magnetic starters for squirrel-cage motors is announced by SQUARE D, LTD., 100, Aldersgate Street, London, E.C.1. Known as Class 8736, these starters provide a simple and economical method of reversing motors where full motor starting torque will not damage the driven machinery. The complete starter consists of two standard Square D contactors mounted on a common steel base and both electrically and mechanically interlocked. One contactor connects the motor for forward operation while the other connects it for reverse operation by interchanging line wires. A normally-closed auxiliary switch is mounted on each contactor and wired in series with the opposite contactor coil to prevent accidental energising of both contactors at the same time. Further protection is provided by the mechanical interlock and thermal overload relays.

The starters are front wired at the factory and are ready for quick and easy installation. All contactor parts are interchangeable with the company's range of control equipment with comparable ratings. The silver-to-silver contacts can be replaced without disturbing the wiring. Normally-open or normally-closed auxiliary switches for operation of remote control pilot lights or for interlocking operation with other equipment in an automation system are also available. The starters are available in either general purpose or dust- and oil-tight heavy gauge sheet steel enclosures with hinged covers and strong latches.

Kettle Element

The new J.R.D. "Safety First" replacement kettle element offered by J.R.D. ELECTRICS, LTD., Alpha Works, White House Road, Ipswich, has been designed to fit most popular makes of kettle and is guaranteed for twelve months. It incorporates a single movement, double setting safety device and can be low set in the kettle to facilitate boiling of small quantities of water. Diameter of the screwed boss is 1 1/16 in and there is a choice of three loadings, 1,000, 1,250 and 1,500 W. The voltage ranges are 100/120, 200/220 and 230/250 V.

The price of this mineral-embedded rod type element is £1 4s 6d plus 4s 3d for the easy-grip locking nut. Shroud plates, to suit flat type B.S. 562 connectors, are also available, price 1s 4d.

Telegraph Test Equipment

Telegraph distortion measuring equipment, Type 603, made by WINSTON ELECTRONICS, LTD., Shepperton, Middlesex, contains all the facilities for the complete setting and testing of telegraph equipment. It will transmit, when required, several kinds of teleprinter signals, including a preset code character at varying speeds, which can be accurately measured.

Almost perfect test signals can be sent and a known amount of start signal distortion can also be introduced when testing teleprinter apparatus for margin. The equipment will monitor any telegraph signal on working lines with only a negligible insertion loss. Also, it will monitor its own transmitted signal after the signal has been transmitted over a line and back. It will accurately set high speed telegraph relays via a special socket. The relays can be set for neutrality and transit time, which can be measured on the screen of the instrument.

Tailoring Iron

A new tailoring iron, available in 12 and 15 lb weights, has been developed by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2. The iron has top castings shaped at the toe to facilitate pressing in seams and pockets, while the design of the cork handle ensures comfortable, cool handling. The flex is connected direct to the terminals in the back of the iron, and taken away at an angle so as not to impede the operator. The single heat mica-insulated clamp elements are loaded as high as is consistent with long life, for speedy operation, being 750 W and 1 kW respectively. The overall finish of the body, handle bracket and sole plate is polished nickel plate. Sole dimensions of the 12 lb iron are 8½in by 2¾in and of the 15 lb iron 11in by 3¾in. The prices are £4 17s 6d (Cat. No. HO.5872) and £6 12s 6d (Cat. No. HO.5874) respectively.

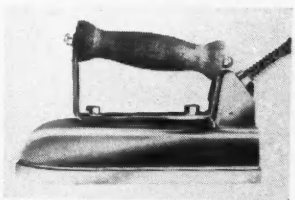
New ancillary equipment introduced includes a swivel arm flex support finished in cream stoved enamel and a separate variable heat control finished in cream enamel with a white "Bakelite" control knob and plug. The flex support comprises a length of conduit on a baseplate which can be screwed to the pressing table. This conduit is terminated with a swivel joint and a swan-neck rod, from which are suspended a spring and cable clamp. When the flexible cable on the iron is attached to the cable clamp, 3ft 6in above the table level, it is held completely clear of the operator, while the action of the spring and swivel device permits movement of the flex up and down the board. The price is £1 15s.

The variable heat switch control unit operates on a time cycle and is actuated by a small self-contained heater coil. An infinitely variable dial enables the required heat output to be obtained. Dimensions of the unit are 6in by 3¼in and the price is £3 5s.

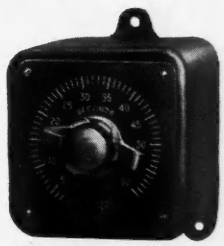
Process Timer

The redesign of their synchronous motor driven process timer, which now incorporates a push-button for repeating a set timing period mechanically, has been announced by VENNER, LTD., Kingston By-Pass, New Malden, Surrey. This PT4 process timer supersedes the non-repeating type PT3 and repeats the set timing period each time the push-button is pressed.

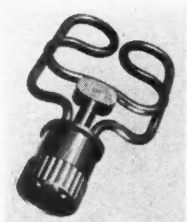
To set the timer the pointer is turned to the required period and secured by means of a knurled locking ring. On pressing the centre push-button, the contacts change over and the set timing period commences. At the end of this time the contacts change back and the timer accurately resets, ready to repeat the period when the push-button is



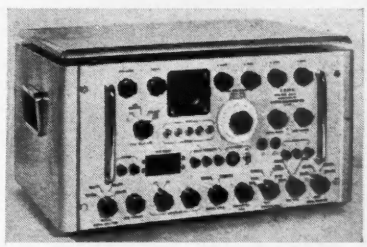
New G.E.C. tailoring iron



Venner PT4 process timer



J.R.D. Electrics "Safety First" kettle element



Winston telegraph distortion measuring equipment

again pressed. The push-button revolves when the timer is running and an arrow indicates the unexpired time.

The timer, which is available in seven ranges, from 3-60 sec to 2-40 hr, is rated at 15 A. The price is £7 19s 9d, or £7 12s 3d for a flush mounting model.

Fan Heater

A portable fan heater, the "Activair," produced by the KENWOOD MANUFACTURING CO., LTD., Hipley Street, Old Woking, Surrey, is claimed to heat large spaces uniformly, provide localised warmth for drying clothes and hair, and with its "Air-fresher Cell" deodoriser it keeps the air fresh.

Neat and compact (it measures 12in by 12in by 6in), the "Activair" is made in four colours, red, blue, green and gold. A spiral type heating element with switch control gives three different heat settings, while the fan is operated by a separate switch and has three different speeds. The rating is 2 kW, 1 kW or 500 W. A red indicator light glows when the heating element is switched on and a snap-action pre-set thermostat control automatically switches the element off if the heater is overturned, or the air flow restricted, while a metal mesh screen back and front makes it especially safe with children. The price is £9 9s 9d plus £4 3s 3d purchase tax in the United Kingdom.

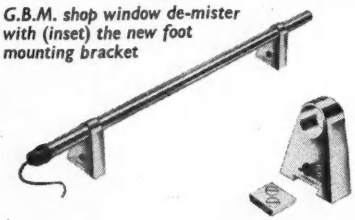
Kenwood "Activair" portable fan heater

Shop Window De-misters

A foot mounting bracket is now available from G.B.M. (ELECTRICAL), BIRMINGHAM, 439, Moseley Road, Birmingham, 12, for use with their range of shop window de-misters. This will enable the de-mister to be easily stored during the summer months without the removal of any screws.

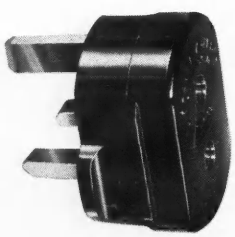
The "G.B.M." de-misters cost from £3 17s 7d for a 2ft length to £8 4s 1d for a 7ft length, and are available in 6in intermediate lengths. The diameter is $\frac{3}{4}$in. The standard finishes are chromium plated or hammered gold, other colours to specification, and the loading is 30 W per foot. An adjustable thermostat (price £2 5s) is also available.

G.B.M. shop window de-mister with (inset) the new foot mounting bracket



Dry Shaver Adaptor

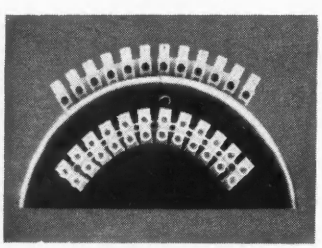
The new SH/135 adaptor now available from GRELCO, LTD., Hopcott, Minehead, Somerset, is designed to solve the problem of using electric dry shavers, fitted with the usual 5 A 2-pin plug on a ring main circuit. The adaptor is a 13 A flat pin type, with one 5 A 2-pin outlet, and is fitted with a 2 A fuse link to B.S. 1362. The price, in brown, is 5s, in white, 5s 9d each.



Grelco dry shaver adaptor

Terminal Strips

Flexible 12-way "Nylon" terminal strips rated at 15 and 25 A have been introduced by the ELKAY ELECTRICAL MANUFACTURING CO., LTD., 42, Woburn Place, London, W.C.1, in addition to the 6 A size already available. The continuous voltage rating is 250 V to earth or 400 V between terminals, and the maximum safe working temperature is 250 deg F continuously or 425 deg F for short periods. They can easily be cut by a knife or saw into smaller sections as required. The 15 A strip measures $5\frac{9}{16}$in long by $\frac{15}{16}$in wide by $\frac{7}{8}$in high and the 25 A size is $6\frac{1}{2}$in long by $1\frac{5}{16}$in by 1in. The respective prices are 8s 6d and 10s 8d.



Elkay terminal strip showing its flexibility in both planes

Heater Tape

The "Handy" heater tape now available from FALK, STADELMANN & CO., LTD., 91, Farringdon Road, London, E.C.1, consists basically of a heating element woven and completely enclosed in flexible glass fibre. It is covered in a black p.v.c. coating, making it completely waterproof, and is obtainable in 12 and 20ft lengths. Each is approximately $\frac{5}{8}$in wide, and the respective loadings are 45/75 W and 120/180 W, operating from normal mains voltages. In appearance the heater tape looks like a length of flat tape, terminating in a moulded 5 A 2-pin connector. The price of the 12ft length is £1 5s 9d (U.95743) and of the 20ft length, £1 14s 9d (U.95744).

Increasing Demand in Ontario

DESPITE the large programme of generating plant construction which the Hydro-Electric Power Commission of Ontario has in hand—last year the dependable peak capacity of all its systems was increased by 395,450 kW—the pressure of demand is such that the margin of power reserve has been reduced. Thus while the proportionate increase in plant capacity last year was 9·6 per cent, demands were up by 14·3 per cent.

In a foreword to the Commission's report for 1955 (its golden jubilee year) Dr. R. L. Hearn, who is shortly retiring from the chairmanship, outlines the Commission's achievements—an increase of 72,977 in the number of consumers served (to a total of 1,540,011), 18·6 per cent more energy generated and purchased, and the extension of service in the rural power district by 1,312 miles of primary distribution lines. The Commission's gross revenue of $166 million in 1955 showed a rise of nearly $19 million.

The major schemes under construction during the year were the St. Lawrence power project (see *Electrical Review*, 30th November, page 999), the pumped storage section of the Sir Adam Beck-Niagara generating station and a hydro-electric development at Manitou Falls on the English River. Dr. Hearn says that all the indications are that after the completion of the St. Lawrence project the Commission will have to turn increasingly to thermal sources to meet advancing power requirements. It already has two large thermal stations, the Richard L. Hearn generating station at Toronto, which is to be extended by the addition of a 200 MW unit, and the J. Clark Keith station at Windsor. The extent to which nuclear resources will help to meet the Commission's needs will depend on experience in the operation of the 20 MW nuclear power demonstration plant to be constructed near the Des Joachims generating station.

The programme of frequency standardisation was accelerated during 1955 and at the end of the year the equipment of 617,260 consumers, or more than half the total number involved, had been changed from 25 to 60 c/s.

GENERATION AND DEVELOPMENT

Recent C.E.A. Contracts

Contracts have been placed by the Central Electricity Authority during the past month for power stations, transforming stations and transmission lines, amounting in the aggregate to £16,920,400. They include the following:—

Northfleet power station: Administration block.—Taylor Woodrow Construction.

Plymouth "B": Structural steelwork.—John Lysaghts Bristol Works.

Drakelow "B": Two 120 MW turbo-generators, condensing and feed heating plants.—C. A. Parsons & Co. 3,300 V and 415 V works auxiliary switchgear.—A. Reyrolle & Co.

High Marnham: One 210 MVA, 275 kV generator transformer.—English Electric Co.

Willington "B": Two 200 MW turbo-generators, condensing and feed heating plants.—Metropolitan-Vickers Electrical Co.

Rugeley: Two 120 MW turbo-generators.—C. A. Parsons & Co.

Aberthaw: Three 100 MW reheat turbo-generators, feed water plant, condensing plant and auxiliary apparatus.—C. A. Parsons & Co.

Elland: Two 72 MVA, 132/11·8 kV generator transformers.—Ferranti.

Skelton Grange "B": Three 120 MW turbo-generators and feed heating plant.—C. A. Parsons & Co.

Blyth "A": Dust handling plant.—Babcock & Wilcox. Two 145 MVA, 13·8/70.8 generator transformers.—Ferranti. 415 V auxiliary switchgear and accessories.—A. Reyrolle & Co.

Belvedere power station substation: Site and foundation works.—J. Jarvis & Sons.

Fawley North substation: Two 30 MVA, 132/11 kV transformers.—Fuller Electrical & Manufacturing Co.

Finchley substation: Two 90 MVA, 132/33 kV transformers and one 60 MVA, 66/33 kV transformer.—Hackbridge & Hewittic Electric Co.

Bangor substation: One 45 MVA, 132/33 kV transformer.—Hackbridge & Hewittic Electric Co.

Rhuddlan substation: One 45 MVA, 132/33 kV transformer.—C. A. Parsons & Co.

Thatcham substation: Two 45 MVA, 132/33 kV transformers.—Fuller Electrical & Manufacturing Co.

Wapley substation: Two 45 MVA, 132/33 kV transformers.—British Thomson-Houston Co.

Chase Terrace substation: Two 45 MVA, 132/33 kV transformers.—British Thomson-Houston Co.

Melksham substation: 275 kV switchgear.—Metropolitan-Vickers Electrical Co.

Tottenham, Brimsdown and Barking substations: 132 kV switchgear.—A. Reyrolle & Co.

Wadeley Bridge substation: Two 30 MVA, 132/11 kV transformers.—C. A. Parsons & Co.

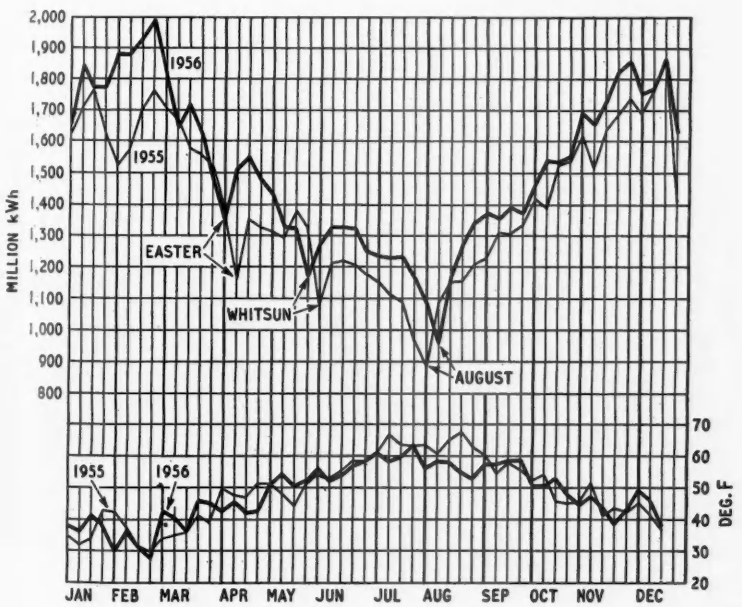
West Weybridge: 132 kV and auxiliary cables.—Pirelli-General Cable Works.

Penn-Round Oak: 132 kV double circuit overhead line.—J. L. Eve Construction Co.

Leicester-Wigan: 132 kV double circuit overhead line.—W. T. Henley's Telegraph Works Co.

Output and Temperature

In the 52 weeks ended 28th December, 1956, 78,867 million kWh was sent out for public supply by solid-fuel fired power stations. This was 5,320 million kWh more than in the previous year, an increase of 7·2 per cent compared with the 11 per cent rise in output in 1955. Temperatures in 1956 were generally below those experienced in 1955. The average for the first 51 weeks of the year was 48·4 deg F against 49·0 deg F in the corresponding period of 1955 and an average of 49·6 deg F for the thirty years 1921-50.



Weekly electricity output (solid-fuel fired stations only) and average temperatures

Coal stocks were better than at the same period of last winter. The weekly statement issued by the Ministry of Fuel and Power shows that, at 22nd December last, stocks at power stations totalled 7·3 million tons, equal to 6·8 weeks' consumption, compared with 6·9 million tons (6·7 weeks' consumption) at 24th December, 1955. Coal consumption by power stations in the 51 weeks to 22nd December last amounted to 44·7 million tons, against 42·1 million tons up to 24th December, 1955.

"Manweb" Sales

Figures published by the Merseyside and North Wales Electricity Board show that last year the Board sold electrical appliances to the value of nearly £1,500,000; this was somewhat less than in 1955 owing to the restrictions on hire purchase. Some 26,000 new premises were connected, including 1,400 farms and 23,000 private houses. To provide new supplies and to reinforce existing networks, the Board laid 650 miles of new mains and commissioned 1,500 new substations. Sales of electricity increased by 9·5 per cent to 4,380 million kWh.

Overhead Line Agreement

Mr. D. J. Glanfield, of Twelve Oaks Farm, Windlesham, Surrey, stated last Saturday that the Southern Electricity Board had agreed to change the route of a 33 kV line which would now run on the edge of his land and for only a quarter of the distance envisaged under the Board's scheme. Only four trees would have to be felled, instead of quite a large number, and the Board had agreed to his valuation of timber and of destruction to amenities.

Mr. Glanfield is seeking an injunction to restrain the Central Electricity Authority from entering his land and placing a pylon there, and from felling or lopping trees and hedges. He pointed out that this was a separate matter from the S.E.B. line which concerned a different part of his land.

Dorset Transmission Line

When the public inquiry into the plan to erect a 132 kV transmission line through Bingham's Melcombe Valley, Dorset, was resumed at Dorchester last week Sir Francis Hopwood said he had it in mind that the property—a fourteenth century manor house and some 800 acres of the valley—should go to the nation when it passed from his hands. On behalf of the Council for the Preservation of Rural England, Mr. P. W. MacFarlane said that if the pylons were erected through the valley they would be a "harsh satanical feature in a very attractive piece of country."

Brigadier C. H. Woodhouse, of

Melcombe Horsey, however, supported the route through the valley, saying that if the line were erected over Henning Hill (the alternative route) the pylons would be visible for at least 15 miles.

Sir Hartley Shawcross, Q.C., for Sir Francis Hopwood, alleged that the county planning authority had failed to honour a promise to consult Sir Francis Hopwood if a suggestion to divert the line from the valley was not approved. There was no conceivable reason why the planning committee, in November, 1955, should not have engaged in full and frank consultation with local owners and national bodies.

Lady Digby, a county councillor, who gave evidence for the planning authority, said that a sub-committee who visited the site felt that the alternative route proposed would involve the pylons standing right up against the skyline, the line would cross over more people's land and cost more money.

The inquiry closed on 3rd January.

GENERATING PLANT INSTALLED IN 1956

AS was reported in the *Electrical Review* last week, new generating plant installed by the Central Electricity Authority during the year ended 31st December, 1956, represented an additional output capacity of 1,797 MW. In addition, new plant with an output capacity of 140 MW was commissioned in power stations owned by the South of Scotland Electricity Board, making a total of 1,937 MW of generating capacity provided in the area of the former British Electricity Authority. This surpasses last year's record total of 1,721 MW by 12½ per cent.

The additional C.E.A. plant, comprising 38 turbo-generators with an aggregate installed capacity of 1,920 MW and 50 boilers having an aggregate evaporative capacity of 18,715 klb/hr, was installed in 33 power stations. Four of them are new stations in which plant was installed for the first time.

In view of misunderstandings which appear to exist in certain quarters regarding the length of time required for the construction of conventional steam power stations, periods of seven or eight years often being quoted, the Authority points out that the initial construction time following Ministerial consent is usually about 3½ years.

In the case of the twin Stella power stations on the Tyne, the first unit was generating power 3½ years after consent and eight more units, making 540 MW capacity in all, were installed within a further period of twenty-four months. At Ince power station in Cheshire, the first unit was also generating electricity 3½ years after consent to proceed and the station of 240 MW was completed by the installation of three more units within the next twenty-one months.

The full development of the Marchwood site on Southampton Water envisages the installation of eight 60 MW units planned to be installed in two groups. The installation of the first four sets in this station has now been completed. The first set was commissioned 3¼ years from the commencement of site work and the next three sets were commissioned within a further period of twelve months, thus increasing the plant available in the area by 240 MW. This result was achieved notwithstanding the complexities involved in carrying out the decision that oil should be burned in this station for which change formal consent was given only nine months before commissioning of the first generating set.

The Authority pays a tribute to the efforts of its construction staff, the plant manufacturers and building and civil engineering contractors and all others concerned in achieving these results. The following table gives details of the major new plant installed by the C.E.A. last year.

PLANT COMMISSIONED BY THE C.E.A. IN 1956

Name of Station	Division	Turbo-Generator Plant		Boiler Plant		Main H.P. Pipework
		Installed Capacity MW	Makers	Capacity klb/hr	Makers	Makers
Steam Plant						
Acton Lane " B "	London	—	—	1 × 240	Mitchell	Aiton
Bold " A "	N. West, Merseyside & N. Wales	1 × 30	Metropolitan-Vickers	1 × 300	Yarrow	Aiton
Brunswick Wharf	London	1 × 60	Metropolitan-Vickers	1 × 320	John Brown	C. A. Parsons
Carmarthen Bay	South Wales	1 × 60	Metropolitan-Vickers	2 × 240	Babcock & Wilcox	Stewarts & Lloyds
Carrington	N. West, Merseyside & N. Wales	1 × 60	Metropolitan-Vickers	2 × 360	John Brown	Stewarts & Lloyds
Castle Donington*	East Midlands	1 × 100	Metropolitan-Vickers	2 × 830	Babcock & Wilcox	Aiton
Chadderton " B "	N. West, Merseyside & N. Wales	1 × 60	Metropolitan-Vickers	1 × 360	Simon Carves	Stewarts & Lloyds
Connahs Quay	N. West, Merseyside & N. Wales	1 × 30	C. A. Parsons	1 × 300	International Combustion	John Thompson
Deptford East H.P.	London	—	—	1 × 250	Foster Wheeler	John Thompson
Doncaster " B "	Yorkshire	2 × 30	Brush	—	—	Aiton
East Yelland	South Western	2 × 30	C. A. Parsons	4 × 180	John Thompson	C. A. Parsons
Goldington	Eastern	2 × 30	British Thomson-Houston	2 × 300	Clarke Chapman	Stewarts & Lloyds
Hams Hall " C "*	Midlands	2 × 60	General Electric Co.	2 × 550	Simon Carves	Stewarts & Lloyds
Huddersfield	Yorkshire	—	—	1 × 180	Bennis	C. A. Parsons
Huncoat	N. West, Merseyside & N. Wales	1 × 30	General Electric Co.	1 × 305	Simon Carves	C. A. Parsons
Ince	N. West, Merseyside & N. Wales	1 × 60	General Electric Co.	1 × 550	International Combustion	Babcock & Wilcox
Littlebrook " C "	South Eastern	1 × 60	C. A. Parsons	—	—	C. A. Parsons
Marchwood	Southern	3 × 60	English Electric	3 × 550	John Thompson	John Thompson
Meaford " B "	Midlands/Headquarters	1 × 60	British Thomson-Houston	2 × 515	Babcock & Wilcox	Babcock & Wilcox
Northampton H.P.	East Midlands	1 × 30	Brush	2 × 150	Bennis	Stewarts & Lloyds
Nottingham H.P.	East Midlands	—	—	1 × 300	Mitchell	Aiton
Ocker Hill " A "	Midlands	2 × 30	Richardsons Westgarth	2 × 180	Babcock & Wilcox	Aiton
Portishead " B "	South Western	1 × 60	Metropolitan-Vickers	3 × 300	Mitchell	Stewarts & Lloyds
Skelton Grange " A "	Yorkshire	—	—	1 × 550	International Combustion	Aiton
Staythorpe " A "	East Midlands	1 × 60	British Thomson-Houston	1 × 240	Babcock & Wilcox	Babcock & Wilcox
Stella North	North Eastern	2 × 60	C. A. Parsons	2 × 550	Clarke Chapman	C. A. Parsons
Stella South	North Eastern	2 × 60	C. A. Parsons	2 × 550	Clarke Chapman	C. A. Parsons
Tilbury " A "*	Eastern	3 × 60	English Electric	3 × 540	John Thompson	John Thompson
Uskmouth " A "	South Wales	1 × 60	General Electric Co.	—	—	Aiton
Wakefield " B "	Yorkshire	2 × 60	English Electric	2 × 550	Foster Wheeler	Aiton
Woolwich	London	—	—	1 × 180	John Thompson	C. A. Parsons
York	North Eastern/Yorkshire	1 × 20	Brush	2 × 100	Richardsons Westgarth	John Thompson
	Totals	38 and 1,920 MW	Totals	50 and 18,715 klb/hr		
Diesel Plant		kW				
Machynlleth " B "*	N. West, Merseyside & N. Wales	3 × 1,330	Mirrlees, Bickerton & Day			
	Totals	3 and 1·33 MW				

* Stations in which plant was commissioned for the first time in 1956.

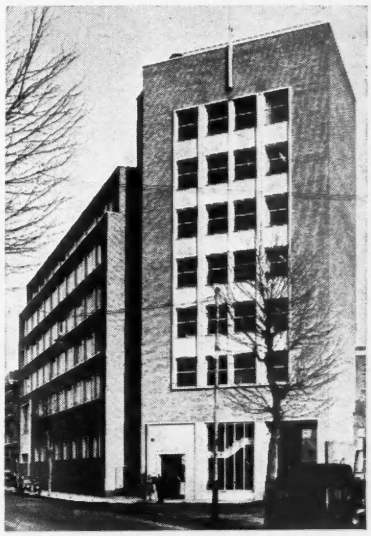
New L.E.B. Substation

PLANT INSTALLED IN OFFICE BLOCK

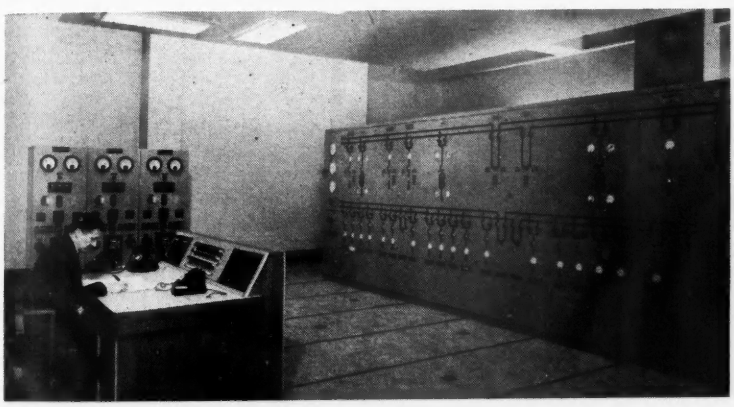
THE new six-floor office building which was recently opened to accommodate the centralised accounts department of the London Electricity Board's South London area also houses a major electricity supply substation. The substation occupies the basement and parts of the ground and first floors. Supplies to the substation are taken at 22 kV from Bankside and Deptford West power stations. Three 15 MVA, 22/11 kV transformers on the ground floor of the building feed the 11 kV busbars, from which fifteen outgoing feeders supply the Southwark area, where the loads range from heavy industrial plant to domestic consumers. Provision has been made for installing a fourth transformer at a later date.

The 22 kV and 11 kV switchgear and the control board for the substation have been supplied by the General Electric Co., Ltd. In the 12-panel, duplicate busbar 22 kV switchboard the 500 MVA circuit-breakers are arranged for vertical isolation by self-contained, motor-operated hoists. The beams which support each breaker form the rails on which it is traversed for connection to the front or rear busbars. The breakers in the 22-panel, 11 kV duplicate busbar board are rated at 250 MVA and also have vertical isolation, but with hand-operated hoists. Each unit is mounted in a wheeled carriage which serves both for withdrawal and for traversing between busbars. All switchgear is solenoid-operated from a 110 V d.c. supply.

All feeder and transformer units in the 22 kV board are equipped for core balance bus zone protection. Overcurrent, earth fault, Buchholz and winding temperature protection is afforded for the transformer units and overcurrent and Beard Hunter protection for the feeder units.



Newington House, the new office block of the London Electricity Board in Southwark, which houses a 45 MVA substation



Substation control room at Newington House

The three 22/11 kV Fuller transformers

The control board, on the first floor of the building, is provided with a mimic diagram showing the 22 kV and 11 kV switchgear, busbars and incoming and outgoing feeders. Indicator lamps are illuminated when the incoming feeders are alive although the corresponding circuit-breakers may be open. All switchgear is operated from the board by means of discrepancy switches. Indication of busbar selection is also given by means of discrepancy switches.

Alarms are given by a bell and their nature is described on an illuminated fascia on the control desk. If the cause of the alarm is the automatic tripping of a circuit-breaker, the corresponding discrepancy switch lamp lights up and a buzzer sounds in addition to the bell signal. In either case the bell is silenced by operating an "accept" button, but when a trip has occurred the control board lamp remains alight and the buzzer sounds until the board has been redressed.

The basement of the building accommodates the 22 kV and 11 kV main and multicore cables, heating services, strong room, etc. The staff at the Newington House offices numbers about 350.

Rural Ring Main

Douglas (I.O.M.) Corporation Electricity Committee has authorised the carrying out of a scheme for the extension of the h.v. mains between Bay View and Ballacrink substation to complete the ring main in the rural area at a cost of £3,194.

Financial Section

STOCKS and SHARES

THE recovery movement in Government stocks has made further ground, helping in the process to sustain a firm trend in most other sections of the Stock Exchange. A rise of nearly three points in the price of War Loan within the space of a month ranks as decidedly fast moving by gilt-edged standards. It is ascribed in large part to the spread of the idea that events will call before long for relaxation in the Government's dear money policy, and that the present high level of yields on gilt-edged securities will not remain available indefinitely to the investor. In the group of British Electricity stocks, prices have put on about two to three points in recent weeks. In the electrical equipment market many prices have again moved upwards, although among the nuclear power company shares there has been a general halt for consolidation of previous gains.

Price Changes

G.E.C. shares remained very firm after the final instalment on the new shares had been paid up; having risen by a further half-a-crown, to 52s 6d, they stood 10s above the price ruling a month earlier. There has again been a lively market in the new shares offered to the stockholders of C. A. Parsons and A. Reyrolle, on both of which issues payment in full is due by next Wednesday (16th). A considerable turnover produced no significant change in the premiums, which remained at around 22s 6d for Parsons and 21s 3d for Reyrolle. In advance of the results, Westinghouse Brake jumped 3s 9d to 72s 6d, and were called 75s in the market after the announcement of an 18 per cent dividend (as before) and of higher earnings. Lucas put on another 1s 3d to 32s, and S. Smith were marked up to 13s 6d. Among numerous other improvements, mention may be made of the gains in Automatic Telephone, Thorn Electrical, Hoover, Electric Construction, Johnson & Phillips and E.M.I.

Dewhurst Meeting

The 2s shares of Dewhurst & Partner were dealt in at over 7s (the official quotation being 1s up at 6s 9d) after the annual meeting of the company. The chairman reviewed another year of successful progress, and reported a very high level of orders in the current period. He expected that by the end of this summer the company would be in occupation of new buildings, of which the construction and equipment will have cost about £100,000, all of this being available within the financial resources accumulated with that purpose in view. Net profit for the last year increased from £107,000 to £125,000, which gave more than threefold cover for the dividend of 16¼ per cent. This represented a moderate increase on the previous distribution, allowing for an intervening 100 per cent scrip issue, which brought the

Price Changes in

Company or Board	Nom. Value	Middle price 7th Jan.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	75½		3	3	3 19 6	80½	72½
Brit. Elec. 1974/77	100	74½	+1	3	3	4 0 6	79⅛	71½
Brit. Elec. 1976/79	100	78½	+1	3½	3½	4 9 3	84	74½
Brit. Elec. 1974/79	100	88½	+1	4¼	4¼	4 16 0	95	85½
Overseas Electric Supply								
Calcutta Elec.	£1	18/6		6†	6†	9 9 9†	20/9	18/6
East African Power	£1	20/-		7	7	7 0 0	21/3	19/-
Nigerian Elec.	£1	17/6		10	10*	11 8 6	21/-	17/-
Perak Hydro-Elec.	£1	14/-		10	10*	14 5 6	17/6	14/-
Equipment and Manufacturing								
Aberdare Cables	5/-	10/3		17½	17½	8 10 9	13/6	9/9
Aerialite	1/-	5/-		45	48	9 12 0	6/9	4/9
Allen, W. H.	£1	36/3	+1/3	20	10*	5 10 3	39/-	33/6
Aron Elec. Ord.	£1	52/6		15	15	5 14 3	56/-	52/6
Assd. Automation	10/-	18/6	+1/-	10	5	2 14 0	19/-	15/-
Assoc. Elec. Ord.	£1	66/3		14	15	4 10 6	85/6	57/6
Automatic Tel. & El.	£1	56/3	+3/9	15	15	5 6 9	72/6	50/-
Babcock & Wilcox	£1	73/9		15	15	4 1 3	85/6	64/-
Baldwin, H. J.	2/-	4/6		20	20	8 17 9	5/-	3/9
Bakelite	10/-	21/3		16	16	7 10 6	34/-	21/3
Berry's Electric	5/-	5/9		—	10‡	8 14 0	6/6	5/9
British Aluminium	£1	67/6	−1/3	12	12	3 11 0	78/9	40/6
B.I. Callender's	£1	50/3xd	+6d	10	12½	4 19 6	54/3	45/-
B.I. Callender's 6% Pref.	£1	21/3	+6d	6	6	5 13 0	22/6	20/3
British Tabulating	£1	43/6		9	9	4 2 9	51/3	37/3
British Thermostat	5/-	26/3	+1/3	20	25	4 15 3	31/9	24/6
British Vac. Cleaner	5/-	8/-		30	15*	9 7 6	8/9	6/-
Brook Motors	10/-	30/-		25	25	8 6 9	44/-	30/-
Brush Group	5/-	4/6		10	10	11 2 3	7/9	4/6
Bulgin, A. F.	1/-	4/9		45	50	—	5/3	4/-
Burco Dean	5/-	8/9xd		22½	20	11 8 6	13/6	8/3
Chloride El. Storage "A"	£1	58/-	+6d	17½	17½	6 0 9	73/6	55/-
Clarke Chapman	£1	127/6		20	22½	3 10 6	127/6	89/6
Cole, E. K.	5/-	17/3	+9d	17½	17½	5 1 6	22/3	15/-
Cossor, A. C.	5/-	6/-		15	Nil	Nil	10/3	5/-
Crabtree	10/-	23/-		20	20	8 14 0	29/3	23/-
Crompton Parkinson Ord.	5/-	13/9		16	16	5 16 3	15/-	12/3
De La Rue	5/-	16/6	−6d	30	30	9 1 9	20/3	15/-
Decca "A"	4/-	28/3	−6d	56¼	43¾*	6 4 0	44/9	23/3
Desoutter	5/-	29/-		25	30	5 3 6	32/9	25/9
Dewhurst	2/-	6/9	+1/-	30	16¼*	4 16 3	7/6	5/3
Dictograph Tel.	2/-	7/-	+3d	20	20	5 14 3	7/3	5/6
Dubilier Condenser	1/-	5/9		25	30	5 4 3	5/9	3/6
Duport	5/-	17/9		23	25	7 0 9	21/6	13/9
E.M.I.	10/-	26/6	+2/6	15	15	5 13 3	37/-	22/6
Electrical Components	5/-	7/-		25	25	8 18 6*	8/-	6/3
Elec. Construction	£1	23/9	+1/3	8½	8½	7 3 3	29/9	22/6
Elliott Bros.	5/-	27/-	+3d	17½	20‡	3 14 0	36/9	22/6
Enfield Cable Ord.	£1	14/-		Nil	Nil	Nil	19/3	13/-
English Electric	£1	48/9		12½	12½	5 2 6	66/3	43/9
English Electric 3¾% Pref.	£1	13/-		3¾	3¾	5 15 6	14/6	12/6
Ericsson Tel.	5/-	34/6		20†	20†	2 18 0†	42/9	31/-
Ever Ready	5/-	28/9	+6d	35	35	6 1 9	32/9	24/-
Falk Stadelmann	£1	35/9		17½	17½	9 15 9	45/9	35/6
G.E.C. Ord.	£1	52/6	+2/6	12½	14	5 6 9	65/6	41/3
G.E.C. 6½% Pref.	£1	22/-		6½	6½	5 18 3	23/9	21/3
General Cables	5/-	11/3xd		30	30	13 6 9	13/9	11/3
Greenwood & Batley	£1	46/3		17½	17½	7 11 3	47/6	45/-
Hackbridge Holdings	5/-	20/9xd	+9d	25	30	7 4 6	24/6	18/9
Hackbridge & Hewittic	5/-	13/9		30	23*	8 7 9	22/-	13/9
Heatrae	2/-	4/-		15	15	7 10 0	5/1	3/9
Henley's	10/-	16/-	+9d	10½	11½	7 3 9	19/9	14/-
Holophane	5/-	17/6		30	30	8 11 6	21/6	17/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

issued capital up to £360,000. A yield of under 5½ per cent on the shares denotes their high investment ranking.

Murex Statement

Murex £1 shares, now quoted around 66s 3d, have moved irregularly since the issue of last month's statement accompanying the 7½ per cent interim dividend declaration. Some fall was reported in the current demand for certain of the older established products; competition had remained keen, and rising costs were affecting profits. Interest in the shares has been active since the publication of the annual report last September, with reference in particular to comments on the group's concern with some of the less common metals. Some of them, the chairman said, were certain to be in growing demand for application in the fields of nuclear power and electronics. On the present dividend of 20 per cent the yield on the shares is now 6 per cent.

Electrical Investments

Company or Board	Nom. Value	Middle price 7th Jan.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Equipment and Manufacturing—continued						£ s d		
Hoover	5/-	26/9	+2/3	70	50	9 7 0	39/3	23/-
I.C.I.	£1	39/6	+1/3	10	10	5 1 3	49/9	37/3
Intl. Combustion	5/-	20/-		25	20*	5 0 0	25/-	15/3
Johnson & Phillips	£1	30/-	+1/3	15	15	10 0 0	46/6	27/6
Lancashire Dynamo	£1	37/6		15	11*	5 17 0	49/9	37/6
Laurence, Scott	5/-	14/3	+6d	12½	15	5 5 3	16/9	13/3
Lister, R. A.	£1	27/6	+1/9	9·3	10	7 5 6	35/3	24/6
London Elec. Wire	£1	43/-	+6d	12½	12½	5 16 3	52/9	42/6
Lucas, J.	£1	32/-	+1/3	7½	7½	4 13 9	40/3	28/9
Marryat & Scott	2/-	8/6	−3d	30	30	7 1 3	11/3	8/9
Macher & Platt	£1	51/6		15	15	5 16 6	65/3	50/-
Metal Industries	£1	23/-		9	9	—	27/-	16/3
Midland Elec. Mfg.	£1	45/-		10	12½	5 11 0	48/6	43/6
Morphy-Richards	4/-	12/-		50	50	—	13/9	10/-
Murex	£1	66/3	−9d	20	20	6 0 9	74/6	60/-
Newman Ind.	2/-	2/3		10	10	8 17 9	2/9	2/1
Oldham & Son	1/-	2/6		20	17½*	7 0 0	3/-	2/3
Parnall (Yate)	5/-	6/-	+3d	14	12	10 0 0	9/6	5/6
Parsons, C. A.	£1	52/6		10	10	—	—	—
Plessey	10/-	61/3	+3d	27½	30	4 18 0	87/6	56/-
Pye "A" Deferred	5/-	16/3		12½	12½	3 17 0	21/3	13/3
Reyrolle	£1	92/6	+1/3	15	16½	3 10 3	117/6	81/-
Rheostatic	4/-	9/-		18½	12‡	5 6 9	—	8/3
Richardsons Westgarth	5/-	17/3		16⅝	16⅝	4 16 6	17/3	13/9
Scottish Cables	4/-	15/9	+6d	27½	27½	6 19 9	17/9	14/9
Smith (England), S.	4/-	13/6	+9d	17½	17½	5 3 9	14/3	10/6
Southern Areas	£1	13/9		10	7½	10 18 3	28/9	13/9
Strand Elec.	5/-	7/9		15	15	9 13 6	8/6	6/9
Sturtevant	5/-	24/-	+6d	14·4†	15†	3 2 6†	31/3	21/3
Sun Elec.	£1	42/6		20	25	11 15 3	42/6	33/9
Switchgear & Cowans	5/-	13/-		20	25	9 12 3	17/-	12/9
Taylor Tunnicliff	5/-	11/9		15	15	6 7 9	14/-	11/3
T.C.C.	10/-	33/9		25	25	7 8 3	45/-	33/9
T.C. & M.	£1	25/-	+6d	8½	8½	6 16 0	34/-	24/-
Telephone Mfg.	5/-	6/6		10	10*	7 13 9	8/6	6/-
Thorn Elec.	5/-	17/6	+1/6	15	15	4 5 9	22/6	15/-
Thornycroft	£1	33/9		15	12½	7 8 3	49/9	33/6
Tube Investments	£1	59/6	+2/-	22½	15*‡	5 0 9	70/6	50/9
Vactric	5/-	13/-		15	17½*	6 14 6	15/-	11/-
Veritys	5/-	9/3		12½	12½	6 15 3	10/-	6/9
Walsall Conduits	4/-	11/9	+3d	70	20*	6 16 3	13/6	10/9
Ward & Goldstone	5/-	37/-	−6d	30	35	4 14 6	39/6	29/-
Watford	2/-	6/3	+3d	25	25	8 0 0	7/6	5/6
Westinghouse	£1	72/6	+3/9	18	18	4 19 3	100/-	67/6
West, Allen	5/-	12/6	+6d	15	15	6 0 0	14/6	11/3
Wolf Electric	5/-	17/6		20	20	5 14 3	26/3	17/6
Trusts, Transport and Communications								
Anglo-Portuguese	£1	21/3		8	8	7 10 6	23/6	20/3
Brit. Elec. Traction: Def. Ord. "A"	5/-	18/6	+6d	22½	22½	6 1 6	20/-	15/6
Cable & Wireless: Ord.	5/-	10/-	+6d	10	10	5 0 0	11/3	9/3
4% Loan	100	90½		4	4	4 8 6	92½	88
Calcutta Trams	£1	23/-	−9d	7½†	8½†	7 7 9†	27/6	23/-
Cape Elec. Trams	£1	15/6		8	8	10 6 6	20/3	15/6
Marconi Marine	£1	31/6		10	10	6 7 0	34/-	31/-
Oriental Tel. Ord.	1/-	72/6	+5/-	16	—	—	90/-	66/3
Telephone Rentals	5/-	10/3xd	+3d	12½	12½	6 2 0	11/9	9/6

Colvern Dividend

The 5s ordinary shares of Colvern, Ltd., have improved sharply to about 17s 3d since the announcement of a 7½ per cent interim dividend on account of the current year, which runs to the end of March. Last year's results (the first to be published after the marketing of the shares) covered a period of a little over eight months, for which period the company paid dividends of 5 (interim) and 10 per cent. The actual distribution was equivalent to rather more than the rate of 20 per cent per annum indicated at the time of the market introduction. It was well covered by earnings, and market expectations are now based on a total for 1956–57 of not less than 20 per cent, which would produce a yield of 5⅞ per cent on the shares at the present price.

I.C.I. Issue

Dealings were expected to begin to-day (Friday), or at the beginning of next week, in the £40 million issue of Imperial Chemical Industries 5½ per cent convertible loan stock, which has been given an overwhelming reception by the company's stockholders. Forecasts have been virtually unanimous in predicting (subject to events unforeseen) a sizable premium on the issue price of 96, and widespread popularity for the stock when it becomes publicly available in the market. Its appeal has of course a twin basis. As a fixed-interest investment, it offers a good and secure yield over a long period and, presumably, protection for the capital against the eventuality of serious trouble affecting ordinary shares.

Baghdad Light

Last month's annual meeting of Baghdad Light & Power recalled attention to a share which has been the subject of a good deal of speculative interest since the agreement in 1955 for the sale of the undertaking to the Iraq Government. After rising from 56s to 94s at one time, the price of the shares has since been falling away in recognition of the delays likely to occur before liquidation and repayment of capital can take place. It stands now at about 80s. It is now confirmed by the company that certain claims involving very substantial sums remain unsettled. For the present the preparation of a balance-sheet is impracticable, and it would be imprudent to assess the return of capital which may eventually be made.

REPORTS and DIVIDENDS

Burco Dean, Ltd.—The report and accounts now issued show a consolidated trading profit for the year ended 30th September last of £353,422, as compared with £525,442 for the preceding year, and after meeting all charges, including £162,958 for taxation, the net profit is £127,166 (against £221,771). General reserve receives £65,000 and, as already announced, it is proposed to pay a final ordinary dividend of 15 per cent, making 20 per cent for the year.

In his statement accompanying the accounts, Mr. D. K. Ward (chairman) says that there was a fall of 36½ per cent in the group net profit, before taxation, as compared with the last period, although no strict comparison with the last period is possible owing to the incorporation then of several different periods, some greater than twelve months. Most authorities agree that in the first half of 1956 sales of domestic gas and electrical appliances were, with few exceptions, 25 per cent to 30 per cent less than in 1955. The group sales have conformed with this pattern. Profits would have fallen to a greater extent but for improvements in efficiency, the first benefits of a programme of increasing mechanisation. The drop in appliance sales has not been felt in every line made by the group, and in most cases the final weeks of the period saw a recovery in trade to a position slightly in advance of the same period last year. During the year they explored new methods of selling, whilst retaining their good relationship with the wholesale trade. They are making increasing use of industrial designers and consultants and development work has been intensified to widen the range of products. The continuation of the restriction on sales of consumer goods may necessitate a permanent reorganisation of production resources within the group, freeing space for the manufacture of new products. They are encouraging the rapid extension of the die-casting division, which has a well-filled order book, in order that group results will not be dependent on the demand for a narrow section of consumer goods.

Greenwood & Batley, Ltd., have declared an interim dividend of 5 per cent (unchanged).

The Morgan Crucible Co., Ltd., is paying an unchanged interim dividend of 3¾ per cent.

W. H. Allen, Sons & Co., Ltd., have declared an interim dividend of 2½ per cent (against 5 per cent) on doubled capital.

New Companies

B. French (Pakistan), Ltd.—Registered 21st December. Capital £5,000. Electricians, electrical, mechanical and general engineers, etc. Directors: B. French and V. J. B. French. Regd. office: Pike Mills, Green Street, Kidderminster.

Cabot Television, Ltd.—Registered 13th November. Capital £10,000. Manufacturers of and dealers in radio and television equipment, etc. E. F. Radford is permanent director. Regd. office: 141, West Street, Bristol, 3.

G. Robertson (Lancaster), Ltd.—Registered 14th November. Capital £1,500. To acquire the business of an electrical engineer carried on by G. Robertson at Lancaster, etc. Directors: G. Robertson, Mrs. Agnes B. Robertson, F. F. Davies and G. Howarth. Regd. office: 57, Church Street, Lancaster.

Freeman & Co. (Installations), Ltd.—Registered 14th November. Capital £1,000. Electrical engineers, etc. Directors: W. C. Adams, Mrs. Ethel M. Adams and T. W. Adams. Regd. office: 20, Great Chapel Street, W.1.

Rototast Electronic Controls, Ltd.—Registered 20th November. Capital £100. To acquire patents relating to processes or devices for controlling guide mechanisms of all kinds; and to carry on the business of electrical engineers, etc. Directors: H. W. J. Farman, Gertrude C. Farman, L. F. Hartje and H. G. Waldschmidt. Regd. office: 45, Great Peter Street, S.W.1.

Cleanmaster, Ltd. — Registered 20th November. Capital £100. Manufacturers of and dealers in electrical goods of all kinds, etc. Directors: J. L. Concannon and J. J. Riordan. Regd. office: 1, New Burlington Street, W.1.

Ogmore Vale T.V. & I.T.V. Services, Ltd.—Registered 22nd November. Capital £100. Manufacturers of and dealers in radio and television sets, etc. Directors: D. G. Morris, Mrs. Florence P. Morris, I. W. J. Dallimore and S. Morris. Regd. office: Stormy Lane, Nantymoel, Glam.

Ken Talbot & Taylor, Ltd.—Registered 5th December. Capital £1,000. To acquire the business of radio and television engineers carried on by George K. Talbot and Robert Taylor at Blackburn as "Ken Talbot," etc. Directors: G. K. Talbot and R. Taylor (secretary). Regd. office: 54, Whalley Old Road, Blackburn.

E. Platt & Son, Ltd.—Registered 7th December. Capital £2,500. To acquire the business of electricians carried on by Platt & Brown, Ltd., at Ainsdale, etc. Directors: E. Platt and Mrs. Georgina Platt. Regd. office: 104, Station Road, Ainsdale, Southport.

Automatic Switching, Ltd.—Registered 12th December. Capital £100. Directors: L. J. Robson and K. C. Goldie-Morrison. Regd. office: 1, Franciscan Road, Tooting, S.W.17.

M. and D. Massil (Wood Green), Ltd.—Registered 19th December. Capital £100. Manufacturers of and dealers in electrical goods, lighting and heating equipment, woodware, etc. Directors: M. Massil and D. Massil. Regd. office: 18, Turnpike Lane, N.8.

Radiomains, Ltd.—Registered 18th December. Capital £2,500. Rediffusers and relayers of radio and television programmes, manufacturers, importers and exporters of and dealers in radio and television apparatus, etc. Directors: H. P. Taylor and Dorothy M. Taylor. Regd. office: 1, Horsemarket, Kettering.

G. B. Woods, Ltd.—Registered 18th December. Capital £750. To acquire the business of electrical contractors carried on by E. J. Pyle and J. Greener at Hillside, Rockwood Hill Road, Greenside, Ryton on Tyne. Directors: E. J. Pyle and J. Greener. Regd. office: Hillside, Rockwood Hill Road, Ryton on Tyne.

Woods-Turner, Ltd.—Registered 17th December. Capital £1,000. Electrical engineers and contractors, etc. Directors: C. Woods-Turner and Mrs. Hylda Woods-Turner. Regd. office: 29, Brewery Road, Horsell, Woking, Surrey.

Papworths (Bagshot), Ltd.—Registered 17th December. Capital £3,000. Radio and television engineers and contractors, electrical and electronic engineers, etc. Directors: A. T. W. Papworth, Edith E. Papworth and E. W. J. Papworth. Regd. office: High Street, Bagshot, Surrey.

Goods of Scarborough, Ltd.—Registered 14th December. Capital £5,000. Radio, television, telephonic and telegraphic engineers, electrical engineers, etc. Directors: B. E. Good, E. Good, J. Good and Hannah Good. Regd. office: 38, Queen Street, Scarborough.

Petradair, Ltd.—Registered 14th December. Capital £18,000. Manufacturers of and dealers in electronic measuring and test equipment, etc. Regd. office: Warwick House, Warwick Court, Gray's Inn, W.C.1.

Fixters Wholesale Co., Ltd.—Registered 14th December. Capital £500. Wholesale and retail dealers in radio and television aerials, electrical goods, etc. Directors: W. H. Fixter, C. R. Fixter and W. H. Fixter, jun. Regd. office: Southfield Lane, Middlesbrough.

Liquidations

Utilectric, Ltd.—In members' voluntary liquidation. Meeting of members on 11th February at 13, Lever Street, Manchester, 1, to receive an account of the winding up by the liquidator, Mr. W. A. Walton.

Electrical & Radio Installations (Ealing), Ltd.—Third and final dividend of 5s in the £, payable at the offices of the liquidator, 4, Bucklersbury, Cheapside, London, E.C.4.

Bankruptcy

E. Newland, carrying on business as an electrical contractor at 130, Grove Road, Chadwell Heath, Romford, Essex.—Last day for receiving proofs for dividend 15th January. Trustee, Mr. D. A. Jacobs, 18, Bentinck Street, London, W.1.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to the dates mentioned:—

28th January

BIRFLO. No. 752,821. Class 9. Electrically operated valves for controlling the flow of liquid through pipes.—Phosphor Bronze Co., Ltd., Bradford Street, Birmingham, 5.

BIZMAC. No. 754,840. Class 9. Electrical and electronic installations for use in the collection, assembly, storage and furnishing of data and statistical information and parts and fittings.—Radio Corporation of America, New York, U.S.A. Address for service, c/o Stevens, Langner, Parry & Rollinson, 5-9, Quality Court, Chancery Lane, London, W.C.2.

FARIFLEX. No. 755,035. Class 9. Electric cables; and insulated cables used in radio and television.—Shardlow Electric Wires, Ltd., Corn Exchange Buildings, Hanging Ditch, Manchester, 4.

COLOURLAND. No. 755,697. Class 9. Luminous and mechanical advertisement signs, electric vacuum cleaners, electric flat irons, electric kitchen utensils, receiving sets for radio telegraphy and telephony, telephones and instruments and apparatus for teaching.—Colourand, Ltd., 30, Thurloe Street, South Kensington, London, S.W.7.

LA CIMBALI. No. B757,286. Class 11. Electrically heated and gas heated apparatus for making coffee, and parts and fittings.—Officine Cimbali Giuseppe S.p.A., Milan, Italy. Address for service, c/o Haseltine, Lake & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2.

PHENWRAP. No. 757,887. Class 17. Insulating materials made of plastics for electric cables.—Phœnix Rubber Co., Ltd., 91, Bishopsgate, London, E.C.2.

2nd February

DIGATYPE. No. 752,513. Class 9. Electrical apparatus and instruments; and calculating machines.—Doughty Components, Ltd., 19, Fairfield South, Kingston-on-Thames.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

Monday, 14th January

BIRMINGHAM. — Imperial Hotel, 6 p.m. I.E.E. South Midland Supply and Utilisation Group. "Electrical Energy from the Wind," by E. W. Golding.

CARDIFF.—At the South Wales Institute of Engineers, Park Place, 6 p.m. I.E.E. Western Centre. "Flat Pressure Cable," by J. S. Mollerhoj, A. M. Morgan and C. T. W. Sutton.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Informal Meeting. Discussion on "The Influence of Maintenance Requirements on the Design of Industrial Electrical Equipment," opened by H. C. Fox and J. H. Harris.

White Hall Hotel, Bloomsbury Square, W.C.1, 7.30 p.m. A.S.E.E. Central London Branch. "Electric Motor Repairs," by E. W. Hymas, followed by a film.

MALVERN. — Winter Gardens. I.E.E. Malvern and District Group. "Is the Electrical Equipment of the Modern Motor Car Sufficiently Reliable," by Dr. E. A. Watson.

MANCHESTER. — Engineers' Club, Albert Square, 7.30 p.m. Junior Institution of Engineers, North-Western Section. Chairman's address by H. Smethurst.

NEWCASTLE-UPON-TYNE. — Neville Hall, 6.15 p.m. I.E.E. North-Eastern Centre. "Choice of Insulation and Surge Protection of Overhead Transmission Lines of 33 kV and Above," by A. Morris Thomas and D. F. Oakeshott.

PORTSMOUTH.—C.E.A. Conference Room, High Street, 6.30 p.m. I.E.E. Southern Graduate and Student Section. Students' Lecture, "Digital Computers and how they may help the Engineer," by Dr. M. V. Wilkes.

SHEFFIELD.—Livesey Clegg House, 7.30 p.m. Junior Institution of Engineers, Sheffield and District Section. "Some Interesting Safety Devices," by J. L. Faris.

WEMBLEY PARK.—Century Hotel, Forty Avenue, 8.15 p.m. A.S.E.E. North West London Branch. "Ultrasonics in Industry," by W. Owen-Roberts.

Tuesday, 15th January

BOURNEMOUTH. — Grand Hotel, Firvale Road, 8 p.m. A.S.E.E. Bournemouth Branch. "Cathodic Protection," by Dr. W. F. Higgins.

CHELMSFORD. — Public Library, 7 p.m. I.E.E. London Graduate and Student Section, district meeting. "Auto-Following Radar Systems," by J. A. Barber.

COVENTRY.—Electricity Sports and Social Club, Merrick Lodge, St. Nicholas Street. Coventry Electric Club. Electrical "quiz."

EDINBURGH.—Carlton Hotel, North Bridge, 7 p.m. I.E.E. South-East Scotland Sub-Centre. "A Transatlantic Telephone Cable," by Dr. M. J. Kelly, Sir Gordon Radley, G. W. Gilman and R. J. Halsey.

GLASGOW.—Burlington House. Institution of Heating and Ventilating Engineers, Scottish Branch. Ladies' evening.

GLOUCESTER. — Fleece Hotel, Westgate Street, 6.30 p.m. I.E.S. Gloucester and Cheltenham Centre. "X-rays in Industry," by K. R. Alsop.

LEEDS.—C.E.A., Yorkshire Division, Offices, 1, Whitehall Road, 1, 7 p.m. I.E.E. North Midland Graduate and Student Section. Main Centre chairman's address by W. K. Fleming.

LIVERPOOL.—24, Hatton Garden, 6 p.m. I.E.S. Liverpool Centre. "A Review of Street Lighting in Great Britain," by C. C. Smith.

LONDON.—Savoy Place, W.C.2, 6 p.m. I.E.E. Education Discussion Circle. Discussion on "Distribution of Power Supplies in Electrical Laboratories," opened by H. E. Dance and Dr. P. F. Soper.

At the E.L.M.A. Lighting Service Bureau, Savoy Hill, W.C.2, 6.30 p.m. Association of Supervising Electrical Engineers, London National Lecture. "Protective Multiple Earthing and Earthed Concentric Systems," by S. J. Emerson.

1, Birdcage Walk, Westminster, S.W.1, 6.45 p.m. Institution of Mechanical Engineers, Internal Combustion Engine Group. Discussion, "Is there a Future for the Diesel Engine in Combination with the Gas Turbine?"

MANCHESTER.—Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Measurement and Control Group. "Control of Nuclear Reactors," by R. J. Cox and J. Walker.

WORKINGTON.—College of Further Education, 7 p.m. I.E.E. North-Eastern Centre. "Underground Lighting in Coal Mines," by Dr. C. D. J. Statham.

Wednesday, 16th January

BELFAST.—Lombard Café, Lombard Street, 6.30 p.m. I.E.E. Northern Ireland Graduate and Student Section. "Traffic Control," by A. A. Marshall.

FARNBOROUGH.—R.A.E. Technical College, 7.30 p.m. I.E.E. Southern Centre. "Time Sharing as a Basis for Electronic Telephone Switching: A Switched Highways System," by F. C. Nelson.

LONDON.—Café Royal, W, 7 for 7.30 p.m. I.E.E. Utilisation Section. Section dinner-dance.

MANCHESTER. — Engineers' Club, Albert Square, 7 p.m. I.E.E. North Western Graduate and Student Section. "Development of Railway Electrification at Industrial Frequency," by D. G. Cowie and D. N. Cross.

MIDDLESBROUGH.—Cleveland Scientific and Technical Institute, Corporation Road, 6.30 p.m. I.E.S. Tees-Side Group. "Lighting of Small Factories," by J. S. McCulloch.

NEWCASTLE-UPON-TYNE.—King's College, Stephenson Building, 7 p.m. Society of Instrument Technology, Newcastle Section. "Temperature Measurement by Filled Systems," by A. Muir.

PRESTON.—Demonstration Theatre, North Western Electricity Board, 19, Friargate, 7.15 p.m. I.E.S. North Lancashire Group. "The New I.E.S. Code," by H. C. Weston.

RUGBY.—Temple Speech Room, 7.30 p.m. I.E.E. Rugby Sub-Centre. Faraday Lecture on "Nuclear Energy in the Service of Man," by Dr. T. E. Allibone.

SHEFFIELD.—Grand Hotel, 6.30 p.m. I.E.E. Sheffield Sub-Centre. "Flat Pressure Cable," by J. S. Mollerhoj, A. M. Morgan and C. T. W. Sutton.

TREFOREST.—Glamorgan Technical College, 6.30 p.m. British Institution of Radio Engineers, South Wales Section. "Radio Techniques in Post Office Engineering," by C. T. Lamping.

Thursday, 17th January

CARDIFF.—Park Hotel, 6.30 for 7 p.m. South Wales Institute of Engineers. Annual dinner.

CHESTER.—Stafford Hotel, City Road, 7.15 p.m. Incorporated Plant Engineers, Merseyside and North Wales Branch. "Instrumentation and Automation," by R. J. F. Howard.

DUBLIN.—Trinity College, 6 p.m. I.E.E. Irish Branch. "Use of Radio for Communication Links," by D. McKenna.

GLASGOW.—39, Elmbank Crescent, 7 p.m. British Institution of Radio Engineers, Scottish Section. "Industrial Applications of High Speed Pen Recorders," by R. Kasler.

HULL.—Yorkshire Electricity Board Offices, Ferensway, 7.15 p.m. I.E.E. North Midland Centre, district meeting. Main Centre chairman's address, by W. K. Fleming.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Utilisation Section. "Electricity in Modern Commercial Horticulture," by C. A. Cameron Brown and A. W. Gray.

Caxton Hall, Westminster, S.W.1, at 2.30 p.m. Diesel Engineers' and Users' Association. "World Supplies of Oil," by M. E. Hubbard.

MANCHESTER. — Demonstration Theatre, North Western Electricity Board, Town Hall, 7 p.m. I.E.S. Manchester Centre. "Evolution of the I.E.S. Code," by H. C. Weston.

Engineers' Club, Albert Square, 6.45 p.m. Institution of Mechanical Engineers, North Western Branch. Annual general meeting. "Power Station Auxiliary Plant," by G. F. Kennedy and F. J. Hutchinson.

SOUTHAMPTON.—Polygon Hotel, 8 p.m. A.S.E.E. Southampton Branch. "Electrical Accidents and Factory Regulations," by S. J. Emerson. (Joint meeting with Institution of Production Engineers, Southern Section.)

TONBRIDGE.—Rose & Crown Hotel, 8 p.m. A.S.E.E. Kent Branch. "Colour Directional Light as Applied to the Stage," by L. G. Applebee.

Friday, 18th January

BIRMINGHAM.—Town Hall, 6 p.m. I.E.E. South Midland Centre. Faraday Lecture on "Nuclear Energy in the Service of Man," by Dr. T. E. Allibone.

HANLEY.—Twyford Scout Hall, 7 p.m. I.E.E. North Staffordshire Sub-Centre. "Digital Computers," by Dr. S. H. Hollingdale, and "Power System Engineering Problems with reference to the use of Digital Computers," by C. Robinson and D. H. Tompsett.

LEEDS.—Powolnys Restaurant. Institution of Heating and Ventilating Engineers, Yorkshire Branch. Annual dinner and dance.

NEWCASTLE-UPON-TYNE.—King's College, 6.30 p.m. I.E.E. North Eastern Graduate and Student Section. "Thermal Endurance of Insulating Materials," by J. A. Denham.

PLYMOUTH.—South Western Electricity Board Showrooms, New George Street, 3 p.m. I.E.E. South Western Sub-Centre. "Highland Water Power," by the late T. Lawrie, to be read by a senior member of the staff of the North of Scotland Hydro-Electric Board. Visit of President, Sir Gordon Radley.

Grand Hotel, The Hoe, 7 p.m. I.E.E. South Western Sub-Centre. Dinner.

Saturday, 19th January

LIVERPOOL.—A.S.E.E. Liverpool Branch. Visit to the Mersey Tunnel, control room and ventilating station (2.45 p.m.).

LONDON.—I.E.E. London Graduate and Student Section. Visit to the brewery of Arthur Guinness, Son & Co., Ltd., Park Royal, N.W.10 (10 a.m.).

OXFORD.—Regents Park College, Pusey Street, 6.30 p.m. A.S.E.E. Oxford, Reading & Districts Branch. "Interference Suppression," by A. P. Hale.

I.E.E. North Western Centre

The annual dinner of the North Western Centre of the Institution of Electrical Engineers will be held on 12th March at the Midland Hotel, Manchester. Applications for tickets (£1 7s each) should be made by 31st January to Mr. T. T. Evans, hon. secretary, c/o Room B46, Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester, 17.

E.I.B.A. Manchester Branch

The annual general meeting of the Manchester and District Branch of the Electrical Industries Benevolent Association will be held on 28th January (5 p.m.) at the Engineers' Club, Albert Square, Manchester.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 16th January from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1951

23965 and 24242. Cosmocord, Ltd., and Sturm, R. H.—Piezo-electric devices. 8th October, 1952. (765835/6.)

1952

1243. Automatic Telephone & Electric Co., Ltd.—Telephone systems. 15th January, 1953. (765925.) 12063. Telecommunication systems. 11th May, 1953. (765926.)

7711. National Research Development Corporation.—Apparatus for synchronising electric signals. 20th March, 1953. (766251.)

11789. Standard Telephones & Cables, Ltd.—Railway route-establishing equipment. 9th May, 1952. (766179.)

22294. Metropolitan-Vickers Electrical Co., Ltd.—Operation and control of electric generators. 27th August, 1953. (766149.)

26509. International Business Machines Corporation.—Pulse responsive electronic circuit. 22nd October, 1952. (765932.)

29273. Staatsbedrijf der Posterijen Telegrafie en Telefonie.—Electronic transmitter, receiver and regenerative repeater for telegraph signals in a start-stop code. 19th November, 1952. (765953.)

29365. General Electric Co., Ltd., and Jenkins, H. G.—Low-pressure fluorescent electric-discharge lamps. 20th November, 1953. (766150.)

1953

8686. National Research Development Corporation.—Electron-discharge tubes. 28th June, 1954. (Cognate applications 8688, 30th March, 1953, and 15237, 24th May, 1954.) (766064.)

11382 and 12932. General Electric Co., Ltd.—Luminescent materials. 23rd April, 1954. (766043/4.)

14581-2 and 23193. Beresford & Son, Ltd., J.—Submersible electric motors. 26th May and 12th August, 1954. (765936-8.)

16007. Crosfield, Ltd., J. F.—Control of reversible electric servo-motors by electron-discharge valves. 10th September, 1954. (765916.) 17067. Electrically controlled servo systems. 10th September, 1954. (765917.)

19242. General Electric Co., Ltd., Hunt, B. E., and McKeag, A. H.—Manufacture of luminescent materials. 12th July, 1954. (765964.)

23710. Muirhead & Co., Ltd.—Facsimile receivers. 18th August, 1954. (766004.)

24189. English Electric Valve Co., Ltd.—Ultra-high-frequency electromagnetic waveguides. 1st September, 1954. (766068.)

25563. Electric & Musical Industries, Ltd.—Remote control of radio apparatus. 16th September, 1954. (765968.)

26238. British Thomson-Houston Co., Ltd.—Electric lamp manufacturing machines. 23rd September, 1953. (766185.)

27687. Philco Corporation.—Electron-discharge devices. 8th October, 1953. (766005.)

28270. Standard Telephones & Cables, Ltd.—Travelling wave tubes. 14th October, 1953. (766007.)

31207. Westinghouse Electric International Co.—Gaseous electric-discharge devices. 11th November, 1953. (766153.)

33773. General Electric Co., Ltd.—Electrical telecommunication systems. 24th February, 1955. (765969.)

34036. General Electric Co., Ltd., and Gordon, G.—Apparatus for deriving voltages that are approximately proportional to predetermined functions of angles. 25th November, 1954. (765788.)

34762/3. Philips Electrical Industries, Ltd.—Manufacture of permanent magnets. 14th December, 1953. (766045/6.)

35444. Hazeltine Corporation.—Frequency difference detector system. 21st December, 1953. (765856.)

1954

6. Ferranti, Ltd.—Magnetrons. 13th January, 1955. (766156.)

55. Reyrolle & Co., Ltd., A.—Current transformer mountings for high voltage electrical apparatus. 3rd January, 1955. (766062.)

271. Cohen, A. M.—Electromagnetic unit. 5th January, 1954. (766009.)

449. International Marine Radio Co., Ltd.—Electronic timing relay. 7th January, 1954. (765935.)

997. Reyrolle & Co., Ltd., A.—Electric protective arrangements. 13th January, 1955. (766063.)

1245. English Electric Co., Ltd.—Electric motor control systems. 14th January, 1955. (Addition to 715583.) (765875.)

2741. English Electric Co., Ltd.—Arrangements for the neutralisation of the inter-electrode capacities of thermionic valves. 28th January, 1955. (765970.)

4195. Standard Telephones & Cables, Ltd.—Beam generating system for cathode-ray tubes employing an ion trap. 12th February, 1954. (766158.)

6097. Singleton, S. A.—Vibrating armature electric pumps. 2nd March, 1955. (765791.)

7438. Standard Telephones & Cables, Ltd.—Waveguide equipment construction. 11th March, 1955. (766074.)

7882. Cobert, A. J.—Electrical control mechanism. 18th March, 1954. (765840.)

8433. Kerrigan, W. P.—Ripple control systems for electricity distribution networks. 23rd March, 1955. (766161.)

12406. Electric & Musical Industries, Ltd.—Magnetic reproducing apparatus. 12th April, 1955. (765861.)

12905. Rotax, Ltd.—Push-button electric switches. 19th April, 1955. (765795.)

13705. Miller, R. R.—Radio pulse echo device with alarm actuated by selected echoes. 11th May, 1954. (766162.)

15873. Siemens & Halske Akt.-Ges.—Condensers. 28th May, 1954. (765973.)

16364. Soc. d'Electronique et d'Automatisme.—Transfer circuits for electric signals. 2nd June, 1954. (765974.)

17740. Rotol, Ltd.—Control means for electro-thermal de-icing systems. 14th June, 1955. (765802.)

18197. Staatsbedrijf der Posterijen Telegrafie en Telefonie.—Gating circuit. 19th November, 1952. (765954.) 18199. Electronic distributor. 19th November, 1952. (Divided out of 765953.) (765955.)

18876. Murphy Radio, Ltd.—Radio navigation systems. 28th June, 1955. (766076.)

18973-4. Automatic Telephone & Electric Co., Ltd.—Telecommunication systems. 15th January, 1953. (Divided out of 765925.) (765927-8.)

20387. Milwaukee Gas Specialty Co.—Lead-tellurium alloy electrical conductor elements. 12th July, 1954. (765884.)

22317. Philips Electrical Industries, Ltd.—Electric amplifier circuits employing gas-discharge tubes. 30th July, 1954. (766168.)

22646. Radio Corporation of America.—Semi-conductor devices and methods of making same. 4th August, 1954. (766169.)

24247. Academy Electrical Products Corporation.—Electrical socket outlets. 20th August, 1954. (766017.)

25916. Forges et Ateliers de Constructions Electriques de Jeumont.—Electric switching devices in the form of compressible cables. 7th September, 1954. (766171.)

26704. Union Carbide & Carbon Corporation.—Air-depolarised electric cell. 15th September, 1954. (766173.)

29052. Standard Telephones & Cables, Ltd.—Composite radiation amplifier. 8th October, 1954. (765891.)

30279. Philips Electrical Industries, Ltd.—Luminescent substances. 20th October, 1954. (765977.)

33561. Westinghouse Electric International Co.—A.c. responsive induction instruments. 19th November, 1954. (766080.)

36545. Standard Telephones & Cables, Ltd.—Aircraft radio installation. 17th December, 1954. (766081.)

1955

251-2 and 863. Hoover, Ltd.—Suction cleaners. 4th January and 25th March, 1955. (765857-8 and 766109.)

653. Telefunken Ges. — Cathode-ray tubes. 10th January, 1955. (766083.)

2114. Automatic Electric Laboratories, Inc.—Coin identifying circuit. 24th January, 1955. (765822.)

2937. Ateliers de Constructions Electriques de Charleroi.—Teleprinter system for radio-electric transmission. 1st February, 1955. (766200.)

3075. General Motors Corporation.—Rotatable control devices for operating electric switches. 2nd February, 1955. (766201.)

3687. Westinghouse Electric International Co.—Electric coffee makers. 8th February, 1955. (766204.)

4632. Philco Corporation.—Electrical circuit employing a semi-conductor. 16th February, 1955. (766210.)

6524. Siemens-Schuckertwerke Akt.-Ges.—Contact convertors. 4th March, 1955. (766304.)

6790. Felici, N., and Gartner, E.—Electrostatic machines. 8th March, 1955. (766053.)

6791-2-3. Soc. Anon de Machines Electrostatiques.—Electrostatic machines. 8th March, 1955. (766054-5-6.)

7228. Standard Telephones & Cables, Ltd.—Electrical translation system. 11th March, 1955. (Addition to 659576.) (765825.)

7422. Giannini & Co., Inc., G. M.—Potentiometers and brushes therefor. 14th March, 1955. (765987.)

7850. General Electric Co.—D.c. motors. 17th March, 1955. (765830.)

8149. Philips Electrical Industries, Ltd.—Circuit arrangements supplying a sinusoidal oscillation to a load. 21st March, 1955. (766229.)

8163. Chemische Werke Albert.—Electrical insulators. 21st March, 1955. (766230.)

8247. Siemag Feinmechanische Werke Ges.—Contact devices on calculating machines which control an electromagnetically operated number printing device of a typewriter. 22nd March, 1955. (766092.)

8342. British Thomson-Houston Co., Ltd.—Dynamo-electric machines. 22nd March, 1955. (766238.)

8361. Licentia Patent-Verwaltungs-Ges.—Arrangement for controlling the brightness of electric lamps. 22nd March, 1955. (766097.)

8439. Pirelli Soc. per Azioni.—Coaxial pair electric cables. 23rd March, 1955. (766241.)

8597. Philips Electrical Industries, Ltd.—Step function amplifiers. 24th March, 1955. (766243.) 8598. Circuit arrangements for producing a saw-tooth current in a deflector coil. 24th March, 1955. (766244.) 8778. Negative feed-back transistor amplifiers. 25th March, 1955. (765998.) 8779. Circuits for producing saw-tooth currents in deflection coils of television receivers. 25th March, 1955. (765999.)

[Concluded at foot of page 89

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—G.P.O. 14th February. Bells and buzzers. (E.S.B. 32584/56. Ten/23503.)*

Electricity Trust of South Australia. 26th March. Pipework for Port Augusta "B" power station. (See this issue.)

Bedlington.—U.D.C. 16th February. Electrical equipment for the year ending 31st March, 1958. A. K. Dennis, surveyor, Council Offices, Front Street.

Blackburn.—Borough Council. 5th February. Internal automatic telephone system for new technical college. (See this issue.)

Boldon.—U.D.C. 28th January. Street lighting equipment. (See this issue.)

Ealing.—Borough Council. 30th January. Street lighting equipment. (See this issue.)

Ethiopia.—Imperial Board of Telecommunications. 8th February. Transmitters and equipment. (E.S.B. 32006/56. Ten/23384.)*

Formosa.—Central Trust of China, Purchasing Department. 24th January. Control cable. 29th January. Air cooling equipment for a 40 MVA power transformer and 69 and 161 kV disconnecting switches. 8th February. 2,500 and 3,500 MVA circuit-breakers. 26th February. 50 MVA transformers. (E.S.B. 32516/56.I.C.A. Ten/23495.)*

Friern Barnet.—U.D.C. 1st February. Street lighting lamps for the year commencing 1st April, 1957. (See this issue.)

Gillingham (Kent).—Borough Council. 21st January. Electrical equipment including switches, conduit, wire, cables and lamps for the year ending 31st March, 1958. Borough engineer, Municipal Buildings.

Huddersfield. — Town Council. 28th January. Electric lamps and cables for the year ending 31st March, 1958. Borough engineer, High Street Buildings.

India.—Government of Mysore, Stores Purchase Committee. 18th January. Two 600 kVA transformers, cables and accessories. (E.S.B. 32541/56. Ten/23537.)* 24th January. H.v. metering equipment. (E.S.B. 31841/56 Ten/23345.)*

Government of Bihar Electricity Department. 22nd January. 1,600 11 and 33 kV lightning arrestors. (E.S.B. 32171/56. Ten/23437.)* 24th January. 950 3-phase meters. (E.S.B. 32175/56. Ten/23446.)* 1st February. Meter test benches and various other electrical measuring instruments, relay testers, fault locators, ratiometers, etc. (E.S.B. 32174/56. Ten/23440.)*

Bombay Electricity Board. 28th January. Transmission towers. (E.S.B. 31517/56. Ten/23373.)*

Government of Madras Electricity Department. 18th February. 66 and 110 kV power transformers. (E.S.B. 31800/56. Ten/23353.)*

London.—Westminster City Council. 21st January. Electric lamps and starter batteries for motor vehicles for one year ending 31st March, 1958. Town clerk, Westminster City Hall, W.C.2.

New Zealand.—Wellington City Corporation. Electricity Department. 24th January. Protective relays. (E.S.B. 31933/56. Ten/23362.)*

General Post Office, Wellington. 25th January. Testing instruments and accessories. (E.S.B. 31935/56. Ten/23381.)* 31st January. Signal generators. (E.S.B. 31934/56. Ten/23382.)* 1st February. Voltage stabilisers. (E.S.B. 31936/56. Ten/23361.)*

State Hydro-Electric Department. 28th March. Twelve 220 kV airbreak switches and accessories. (E.S.B. 32488/56. Ten/23494.)*

Auckland Electric Power Board. 15th February. Fifteen 450 kVA transformers. (E.S.B. 32449/56. Ten/23481.)*

Northern Ireland.—Northern Ireland Hospitals Authority. 30th January. Wiring in the new ward kitchens and sanitary annexes at Wavenley Hospital, Ballymena. J. McCandless, consulting engineer, 6, Murray Street, Belfast.

Pakistan.—Department of Supply and Development. 21st January. L.v. underground cable and h.d.b.c. wire. (E.S.B. 31892/56. Ten/23354.)* Fifteen vertical turbine and five centrifugal type pump sets. (E.S.B. 31829/56. Ten/23376.)* 4th February. 400 V switchgear and 11 and 33 kV and lower voltage transformers, cables, lighting equipment and accessories. (E.S.B. 32312/56. Ten/23460.)*

Ministry of Industries. 4th February. 110,000lb overhead electric travelling crane, etc. (E.S.B. 32313/56. Ten/23458.)* Two 7,500 kW turbo-alternators. (E.S.B. 32203/56. Ten/23453.)*

Philippines.—National Economic Council. 21st January. Forty 50 kW diesel generator sets. (E.S.B. 252/57.I.C.A. Ten/23530.)*

Rhodesia and Nyasaland. — City of Bulawayo Electricity Department. 6th February. Enamelled reflectors, plastic shields and aluminium castings for street lighting fittings. (E.S.B. 32187/56. Ten/23445.)*

Ministry of Posts. 15th February. Automatic telephone exchanges for Livingstone, Ndola and Kitwe. (E.S.B. 31596/56. Ten/23377.)*

South Africa.—Union Tender and Supplies Board, 17th January. Laboratory equipment including a muffle furnace. (E.S.B. 31864/56. Ten/23351.)* 24th January. Twenty 4 kVA and twelve 1·9 kVA diesel engine alternator sets. (E.S.B. 32535/56. Ten/23499.)*

Stores Department, South African Railways. 23rd January. Electric cable and copper wire. (E.S.B. 32131-2-3/56. Ten/23407-8-9.)* 25th January. Copper and steel earth wire. (E.S.B. 32134/56. Ten/23410.)* Insulating material. (E.S.B. 32135/56. Ten/23390.)* 30th January. Electrically heated furnace. (E.S.B. 32491/56. Ten/23490.)* 15th March. Electric cable. (E.S.B. 32495/56. Ten/23478.)*

Stockport.—Borough Council. 31st January. Electric lamps, lanterns, chokes, capacitors and time switches for the year ending 31st March, 1958. Borough surveyor, Town Hall.

Sunderland.—Borough Council. 17th January. Electrical installation in additions to the College of Art. Borough architect, Grange House, Stockton Road.

Twickenham.—Borough Council. 23rd February. Street lighting equipment and wash boilers, etc., for one year ending 31st March, 1958. Borough engineer, Municipal Offices.

Uganda.—Electricity Board. 28th February. Overhead line materials and the erection of overhead lines with distribution substations for the Mityana development scheme. (See this issue.)

Uruguay.—Administracion General de las Usinas Electricas y los Telefonos del Estado. 28th February. Twin cable. (E.S.B. 32239/56. Ten/23461.)* Iron supports for insulators. (E.S.B. 32238/56. Ten/23504.)* 1st March. Transformer. (E.S.B. 32237/56. Ten/23509.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

NEW PATENTS (*continued from page* 88)

8653. Elektrokemisk Aktieselskap.—Electrode supporting means for electric furnaces. 24th March, 1955. (Addition to 700218.) (765991.)

8701. Frantellizzi, B.—Automatic control switch for the electric motor winding up a clockwork spring. 25th March, 1955. (766104.)

8706. Standard Telephones & Cables, Ltd.—Location of high resistance faults in cables. 25th March, 1955. (765993.)

8729. Mallory & Co., Inc., P. R.—Electromagnetic vibratory interrupter. 25th March, 1955. (765995.)

8828. Haldex Aktiebolag.—Manufacture of electric coils. 25th March, 1955. (766247.)

8830. Messen-Jaschin, G. A.—Apparatus for removal of electrostatic charges from the surfaces of materials of low conductivity. 25th March, 1955. (766001.)

8955. Officine Meccaniche Riunite Soc. per Azioni.—Contact assemblies for remotely controlled contactors. 28th March, 1955. (766249.)

9083. Babcock & Wilcox, Ltd.—Cyclone furnaces. 29th March, 1955. (766110.)

9291. General Electric Co.—Thermal protection of dual-voltage electric motors. 30th March, 1955. (766032.)

9403. Reeves-Hoffman Corporation.—Piezo-electric crystals. 31st March, 1955. (766033.)

10470. Philips Electrical Industries, Ltd.—Devices comprising a closed circuit of ferro-magnetic material having high retentivity. 12th April, 1955. (766037.)

26939. Huxall, J.—Reels for electric cables. 21st September, 1955. (766174.)

29147. Automatic Telephone & Electric Co., Ltd.—Telecommunication systems. 15th January, 1953. (Divided out of 765925.) (765929.)

1956

10728. International Business Machines Corporation.—Electronic logical circuits. 22nd October, 1952. (Divided out of 765932.) (765933.)

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Barrow-in-Furness.—Houses (180), North Walney estate; J. N. Flitcroft, borough surveyor, Town Hall.

St. Paul's C. of E. Junior School, Hawcoat Lane; F. Gerald Jackson, architect, Lowther Arcade Chambers.

Bexhill.—Flats (21), De La Warr Road; Kalck, Ltd., 23, Brandcaster Lane, Purley.

Birmingham.—Eight-storey block of flats, Church Road, Perry Barr; city architect.

Boldon.—School at Cleadon Lane, Whitburn; county architect, South Street, Durham.

Bracknell.—Houses (605) for Development Corporation; general manager, Farley Hall, Binfield.

Bristol.—Garage and depot, Whitson Street; M. A. Penney, architect, Bristol Tramways & Carriage Co., Ltd.

Cheshire.—Secondary modern school, Sandbach (£229,000) and county primary school, Partington (£81,850); J. G. Kellett, director of education, City Road, Chester.

Cosford.—Houses (60); R.D.C. surveyor, Council Offices, 32, High Street, Hadleigh, Suffolk.

Doncaster.—Houses at Campsall Park (40), Rossington (26) and Edlington (42); R.D.C. architect, Doncaster.

Driffield.—Garage for East Yorkshire Motor Services, Ltd.; E. Barker, Ltd., builders, Marfleet, Hull.

Easington.—Houses (26) at Easington Colliery; R. R. Lumsden, R.D.C. surveyor.

Gateshead.—Houses (1,000), Wardley; G. H. Gray & Partner, Portland Terrace, Newcastle-on-Tyne.

Glendale (Northumberland).—Houses (50), Wooler; A. F. Field, R.D.C. surveyor.

Grassmoor.—Houses (148) and bungalows (38) on the Mill Lane estate; R.D.C. architect, Chesterfield.

Grimsby.—Flats (84), Bath Street; Wilkinson & Houghton, Ltd., builders, Sidney Street, Cleethorpes.

Guisborough.—Houses (400), Hutton Lane estate; U.D.C. surveyor.

Harlow.—Research laboratory at New Town (£250,000) for Standard Telecommunications Laboratories, Ltd., Enfield; Waterhouse & Ripley, architects, Staple Inn Buildings, Holborn, London, W.C.1.

Hebburn.—R.C. school, Argyle Street; county architect, South Street, Durham.

Huddersfield.—Technical training college, Lindley; borough architect, High Street Buildings.

Lindsey.—Grammar technical school at Scunthorpe, secondary modern school at Brigg, and junior school on the Riddings estate, Ashby; county architect, County Offices, Newland, Lincoln.

Middlesbrough.—Methodist church at Whinney Banks; R. Cowan, architect, Finkle Street, Stockton-on-Tees.

Newcastle-on-Tyne.—Bottle factory, Heber Street, for Newcastle Breweries, Ltd., Corporation Street, Newcastle; own architects.

Northallerton.—Houses (84), Bullamoor Road, for U.D.C.; Brierley, Syme and Leckenby, architects, 10, Lendal, York.

Oldbury.—Workshop block for College of Further Education; Richard Sheppard & Partners, architects, 5, Southampton Place, London, W.C.1.

Oxford.—Science laboratories for Magdalen College School; Booth & Ledeboer, architects, 9, Blackhall Road.

Penzance.—Flats (70), St. Clare Street; borough surveyor.

Ponteland.—County modern school; Newcombe & Newcombe, Eldon Square, Newcastle-on-Tyne.

Portsmouth.—Factory, 35-51, Albion Street; B. O. Morris, Ltd., 7, Baker Street, London, W.1.

Reading.—Premises in Merchants Place for Y.M.C.A.; Secretary's Office, 30, Friar Street.

St. Helens.—Open market with three-storey frontage to Bridge Street; M. Ward, borough surveyor, Town Hall.

Scunthorpe.—St. Bede's R.C. Secondary Modern School (£100,000); county architect, Lindsey C.C., Lincoln.

Southampton.—Shops and offices (10), London Road; William Saunders & Son, architects, 1, Carlton Crescent.

Southend-on-Sea.—Houses (195), Blythe Avenue (£293,000); C. S. Wiggins & Sons, builders, Hart Road, Thundersley, Essex.

South Shields.—Warehouse and offices, Mill Dam, for Peterson Bros; Clarence Solomon, architect, 30, St. Mary's Place, Newcastle-on-Tyne, 1.

Factory at Low Simonside for Eskimo Slippers, Ltd., Laygate, South Shields (£80,000).

Stockton-on-Tees. — Proposed Fairfield Junior School; borough architect, 28, The Square.

Houses (43), Green Beck estate; Moorhouse and Barker, Ltd., Thornaby-on-Tees.

Sunderland.—Technical college students' hostel, and R.C. school in Hylton Road; borough architect, Grange House, Stockton Road.

Thorpe.—Houses (40), Laundry Lane; Castons, Ltd., builders, Belmore Road.

West Bromwich.—Six-storey building, Ryders Green; Synthite, Ltd., Ryders Green.

West Hartlepool.—Houses (200) at Seaton Carew; N. G. Sinclair, borough architect.

Whitton.—Parish Church of St. Augustine, Chertsey Road; Dove Bros., Ltd., builders, Cloudesley Place, London, N.1.

Wigan.—Factory in Hodson Street, Wallgate; S. Morris, clothing manufacturer, Frederick Street, Hindley, Wigan.

Woking.—Broadmere Primary School; Griggs & Son, Ltd., builders, 56, Victoria Street, London, S.W.1.

CATALOGUES AND LISTS

BAND HEATERS.—Illustrated leaflet (1/756) describing "Elmatic" ceramic insulated band heaters.—**Elmatic, Ltd.,** Colchester Factory Estate, Cardiff.

CABLE FITTINGS.—Catalogue describing the company's range of cable lugs, solderless terminals, crimping tools and crimping equipment.—**Erma, Ltd.,** Hong Kong Works, Exhibition Grounds, Wembley, Middlesex.

CABLES.—40-page catalogue (S) covering cables for the wiring of ships and for use in the shipbuilding industry generally.—**W. T. Henley's Telegraph Works Co., Ltd.,** 51-53, Hatton Garden, London, E.C.1.

CARBON BRUSH HOLDERS.—Catalogues describing carbon brush holders and motor sliprings produced by Rheinische Kohleburstenfabrik Franz Wenzel KG., and available from the British agents.—**Walter Logan & Co., Ltd.,** 34, Oak Tree Drive, Totteridge, London, N.20.

CATERING EQUIPMENT.—Folder containing five leaflets dealing with mincers and bowl cutters in the company's range of electrical catering machinery.—**Crypto, Ltd.,** North Circular Road, London, N.W.10.

COMPRESSOR.—Leaflet describing the "Mini-Compressor" air pump designed for inflating the tyres of motor vehicles, etc.—**Gennar Engineering, Ltd.,** 99, Old Street, London, E.C.1.

DISPLAY TURNTABLES. — Leaflets showing various models of mains operated and battery operated display turntables and a list of miniature electric motors available from the company.—**Crane Automatic Co., Ltd.,** Hong Kong Works, South Way, Exhibition Grounds, Wembley, Middlesex.

ELECTRIC BLANKETS.—Leaflets giving prices and particulars of the "Warranty" range of electric blankets and the "Magic Brain" infinitely variable temperature control.—**Warranty Electrical Products Co.,** 210, West End Lane, London, N.W.6.

ELECTRIC TOOLS.—88-page illustrated catalogue describing the company's range of electric tools.—**Wolf Electric Tools, Ltd.,** Pioneer Works, Hanger Lane, London, W.5.

FANS.—Illustrated descriptive folder on "Turbro-Cyclone" polyvinyl chloride fans for dealing with chemical fumes, corrosive gases and for laboratory ventilation, etc.—**Matthews & Yates, Ltd.,** Cyclone Works, Swinton, Manchester.

FIRE ALARM EQUIPMENT.—Pamphlet (59) describing electrically operated fire alarm equipment produced by the company.—**Carter & Co. (Nelson), Ltd.,** Nelson, Lancs.

FLOOR WARMING.—Leaflet and descriptive details of the company's "Florawarm" floor heating cables.—**Wandleside Cable Works, Ltd.,** 106, Garratt Lane, Wandsworth, London, S.W.18.

FURNACES.—Two leaflets (M25 and M26) dealing with various types of mains frequency non-ferrous melting furnaces.—**Metalectric Furnaces, Ltd.,** Cornwall Road, Smethwick, 40, Staffs.

Descriptive booklets dealing with continuous conveyor furnaces and the Birlec Detroit rocking arc electric melting furnace.—**Birlec, Ltd.,** Tyburn Road, Erdington, Birmingham, 24.

GENERATING PLANT.—40-page descriptive brochure dealing with automatic power plant and control switchgear.—**Austinlite, Ltd.,** Crawley, Sussex.

LIGHTING FITTINGS. — Catalogue illustrating a range of contemporary glass lighting fittings manufactured by Peill & Putzler Glashüttenwerke G.m.b.H. and available from the British agents.—**Walter Logan & Co., Ltd.,** 34, Oak Tree Drive, Totteridge, London, N.20.

LIMIT SWITCHES.—Pamphlet describing a new range of "Klöckner-Moeller" limit switches now available from the British distributors.—**W. R. Vaughan, Ltd.,** 4, Queen Street, Curzon Street, London, W.1.

LIQUID SCREENS.—12-page descriptive brochure (No. 1050) dealing with automatic liquid screens suitable for installation at generating stations and for other industrial uses.—**F. W. Brackett & Co., Ltd.,** Hythe Bridge Ironworks, Colchester, Essex.

MOTORS.—Illustrated list (ML85) showing typical applications of the company's range of f.h.p. motors.—**Lancashire Dynamo & Crypto, Ltd.,** Trafford Park, Manchester, 17.

PUMPS.—Technical brochure (1506) dealing with the "350" series of vertical high temperature "Mopumps."—**Rhodes, Brydon & Youatt, Ltd.,** Stockport, Cheshire.

RISING MAIN SYSTEMS.—Illustrated 40-page catalogue (856) giving particulars of rising main systems and rising main distribution boards.—**Mantel Metalworkers, Ltd.,** 121, Gurney Street, London, S.E.17.

SPECTROCHEMICAL ANALYSIS. — Five catalogues (CH.401-CH.405) describing a complete range of apparatus for emission spectrochemical analysis.—**Hilger & Watts, Ltd.,** Hilger Division, 98, St. Pancras Way, Camden Road, London, N.W.1.

TELEPHONE EQUIPMENT.—Illustrated booklet describing the company's type 211 extensible private automatic branch exchange.—**Automatic Telephone & Electric Co., Ltd.,** Strowger Works, Liverpool, 7.

WIRING ACCESSORIES. — 80-page priced catalogue (370) covering the M.E.M., Tucker and Kerson ranges of switches, switchplugs and other wiring accessories.—**Midland Electric Manufacturing Co., Ltd.,** Tyseley, Birmingham.

Illustrated and priced 144-page catalogue of electrical wiring accessories.—**Alliance Wholesale, Ltd.,** 240-250, Ferndale Road, London, S.W.9.

Price list giving the latest figures for the company's range of wiring accessories.—**Marbourn, Ltd.,** Roslyn Works, Roslyn Road, South Tottenham, London, N.15.

Amendment slip for catalogue No. 27 giving the revised prices for certain accessories in the Nettle range.—**Nettle Accessories, Ltd.,** Harper Road, Wythenshawe, Manchester, 22.

58-page illustrated catalogue (805/56), together with a separate price list covering a range of electrical wiring accessories and supplies.—**Falk, Stadelmann & Co., Ltd.,** 91, Farringdon Road, London, E.C.1.

. Secondary
nty architect,

offices (10),
ers & Son,

95), Blythe
ins & Sons,
, Essex.
and offices,
s; Clarence
lary's Place,

for Eskimo
uth Shields

d Fairfield
ct, 28, The

; Moorhouse
ees.
ge students'
ylton Road;
se, Stockton

ndry Lane;
Road.
building,
lders Green.
o) at Seaton
rchitect.
t. Augustine,
td., builders,

Street, Wall-
nanufacturer,

ry School;
56, Victoria

ML85) show-
e company's
ire Dynamo
Manchester,

(1506) deal-
vertical high
des, Brydon
ire.
—Illustrated
particulars of
g main dis-
workers, Ltd.,
.17.
ALYSIS. —
5) describing
for emission
r & Watts,
ancras Way,

—Illustrated
's type 211
ch exchange.
ic Co., Ltd.,

— 80-page
the M.E.M.,
of switches,
ccessories.—
Co., Ltd.,

ge catalogue
es.—**Alliance**
ndale Road,

ures for the
ccessories.—
Roslyn Road,

ue No. 27
n accessories
ssories, Ltd.,
nchester, 22.
e (805/56),
t covering a
essories and
Co., Ltd., 91,